Secret

2016-2017 P5

Operations Sector Review

September 13, 2016

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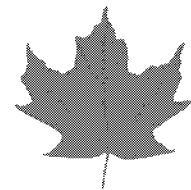
2016-2017 Sector Context and Considerations for the Upcoming Three Years

N/R

N/R

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Citizenship and   Citoyenneté et
Immigration Canada   Immigration Canada

Citizenship and Immigration Canada

2014–2015 Q2

Operations Sector

Executive Summary

Canadä

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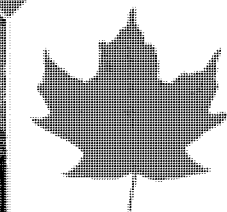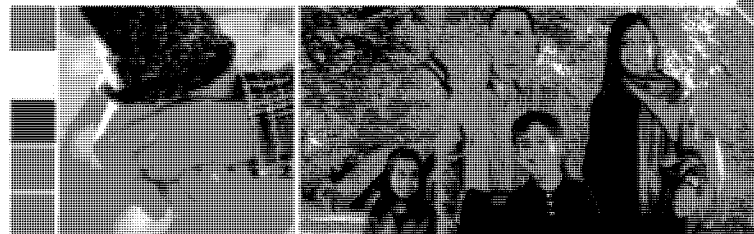
Achievements – OPMB Analytics

✓ **Integrated Workload Distribution Project (IWD)**
  ➤   s.16(1)(b)
  ➤   s.16(2)
  ➤   N/R
  ➤   N/R

✓ **Electronic Travel Authorization**
  ➤   N/R

✓ **Express Entry, phase I:**
  ➤   N/R
  ➤   N/R

✓ **Validated and contributed to OMC-PID's risk profiles on different LOBs**

✓ **Ad-hoc requests and other exploratory projects:**
  ➤   N/R

✓ Contributed to Data Governance ¡
                                                       N/R

✓

Achievements – OPMB Analytics

CIC benefits:

Some notes on number of cases needed for testing or revision of the model for Express Entry once actual data is available

For Express Entry, DPAT should be able to conduct the first testing and if necessary revision of the model when actual FinDec will be available for at least 3,000 applications. This was estimated by conducting several trials on randomly taken sample of 2% (2,936) of FSW data set (the most challenging to model) and the results were proven to be reasonable and valid. The monitoring of Express Entry admissions on weekly basis is necessary to establish the time period for required actual data be available.

As for March 15, 2015, CIC has received 737 applications from invited candidates (about 21.5% of invitations).

Taking into the consideration this recent trend in admissions, DPAT believes that testing and revision of the model have to wait several months with possibility to wait to the end of 2015.

The following is the presentation of results for FSW model for 2% of data that is 2,936 applications.

There were five trials conducted to see if the model still results in accurate prediction for five randomly selected 2% samples of data set.

Trial 1

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Trial 2

Trial 3

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s.16(2)

Trial 4

The comparison of predicted FinDec with Actual FinDec
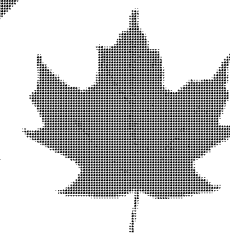
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Trial 5

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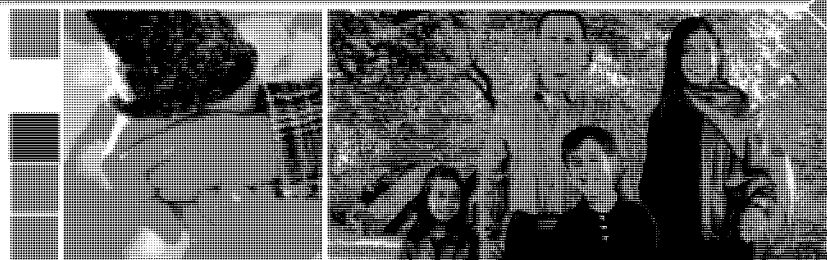
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Trial's Results

The accuracy of the model varied insignificant from 86% to 89% for five randomly selected data samples. This indicates the robustness of the model for 2% sample of the data.

Note The new model will be built using more fields and historical information. This will increase accuracy of the model as it was observed from the work done for other LoBs.
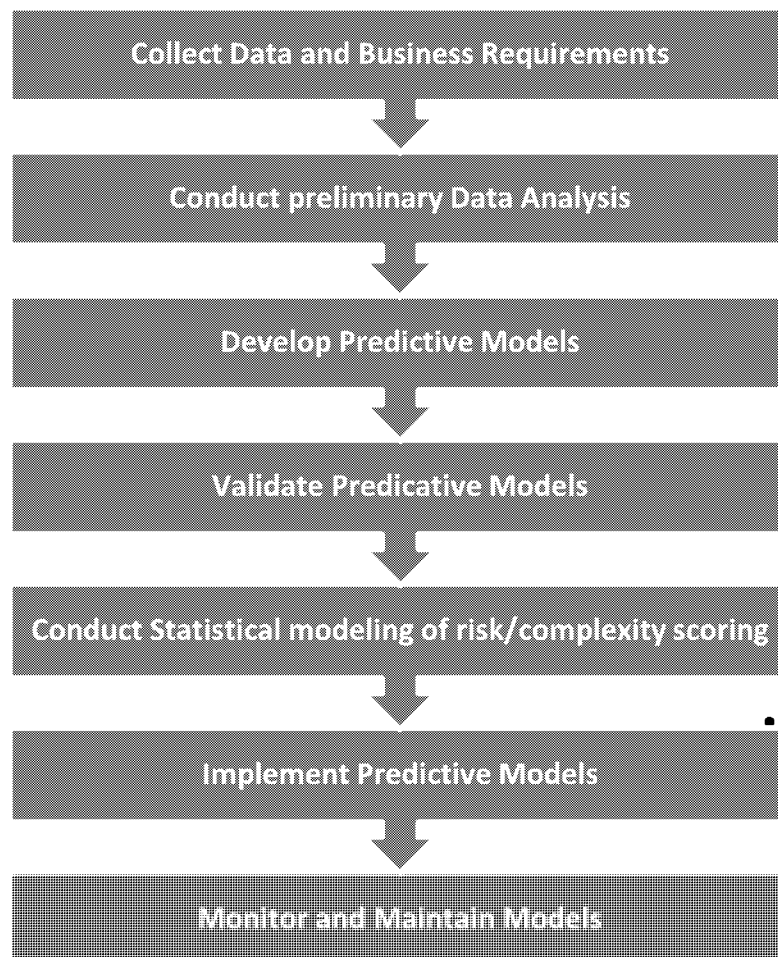
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Predictive Modeling for Express Entry

OPMB-PMU-DPAT

October 2014

Canada

Express Entry Predictive Analytics Modelling

Collect Data and Business Requirements

⬇

Conduct preliminary Data Analysis

⬇

Develop Predictive Models

⬇

Validate Predicative Models

⬇

Conduct Statistical modeling of risk/complexity scoring

⬇

Implement Predictive Models

⬇

Monitor and Maintain Models

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Express Entry- Data Exploration

•Original data set had 547,215 applications with 122 unique fields

  ➢   Federal Skilled Worker Program (FSW)– - **72.13%**
  ➢   Provincial/Territorial Nominees (P/N) - **21.16%**
  ➢   Canadian Experience Class (CEC) - **6.69%**
  ➢   Skilled Trades (ST) - **0.03%**

Distribution by Programs

Skilled Workers	72.13	394689
Provincial/Territorial Nominees	21.16	115772
Canadian Experience Class	6.69	36590
Skilled Trades	0.03	164

• Missing values and outliers were removed from the data for each LOB
• As a result, each LOB has reduced number of records
• Time periods for modeling were also chosen for each LOB depending on availability and quality of the data

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s.16(2)

Express Entry- Data Used (continue)

FSW

- **Total number of valid records consist of 155,665** applications
- Total number of **fields** is **122** unique fields
- **Dates covered** (final decision dates) are from **2007-01-01** to **2008-02-27**
-

PN

- **Total number of valid records consist of 111,060** applications
- Total number of **fields** is **122** unique fields
- **Dates covered** (final decision dates) are from **2007-01-02** to **2014-08-18**
-

CEC

- **Total number of valid records consist of 25,058** applications (GCMS only)
- Total number of **fields** is **122** unique fields
- **Dates covered** (final decision dates) are from **2011-07-16** to **2014-08-15**
-

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Express Entry- Predictive Indicators and Model

- DPAT used Auto data Preparation method to identify the most important predictors for making decision to approve or refuse the application.

- DPAT have looked at different prediction methods, such as Decision Trees (i.e. C5.0, CHIAD...) and Logistic Regression.

- After developing models based on each of these methodologies, we compare the overall accuracy rate, discuss the results with the clients and select the method with the highest possible accuracy rate that meets CIC's needs.

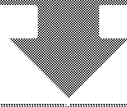# Express Entry – Next Steps

Phase I : Model results are used to produce triaging rules for design of Express Entry

More work needs to be done in the next few months to improve the accuracy and robustness of the models

Phase II : Models will be rebuilt to produce triaging rules for design of Express Entry using Express Entry data

Predictive Analytics on Express Entry will include the future vision of Integrated Workload Distribution

Strategic Business Research Projects

Operations Planning and Performance Branch
Business Research, Intelligence and Analytics Directorate

February 24, 2017

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Background

OPP won two Request for Proposals issued by the Canadian Safety and Security Program (CSSP) to undertake collaborative innovation projects entitled **FASTER PrivBio** and **Chain of Trust**.
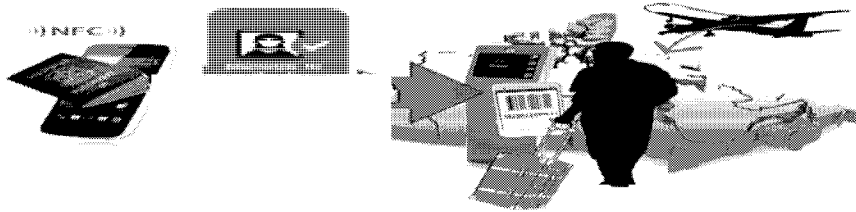
- **FASTER PrivBio** combines the efforts of IRCC, Canada Border Services Agency, WorldReach Software Corporation, University of Ottawa and Ryerson University to develop the prototype of a smartphone application (App) that enables **advance, remote, secure and privacy preserving pre-screening of applicants before they arrive at the physical border. Approved applicants can use the App to self-authenticate and provide travel authorization using the App at self-service border kiosks.**
    - Running on-time and on-budget. Project lifespan from August 2015 to March 2017. Budget of $2.3M; IRCC in-kind investment of $126K; receiving $78K in CSSP funding.
- Building on the successes of FASTER PrivBio, **Chain of Trust** combines the efforts of IRCC, Canada Border Services Agency, WorldReach Software Corporation, Entrust Datacard, Face4 Systems and University of Ottawa to build **automated adjudication rules to continuously assess risks and triage applicants and travellers using the powers of predictive analytics.**
    - Project will run from April 2017 to March 2018. Budget of $2.8M; IRCC in-kind investment of $188K; receiving $237K in CSSP funding.

What is the Canadian Safety and Security Program (CSSP)?

The CSSP is a federally-funded competitive granting program administered by Defence Research and Development Canada (DRDC). The program funds government-led R&D projects in collaboration with response and emergency management organizations, non-governmental agencies, industry, and academia.

- Defence Research and Development Canada's Canadian Safety and Security Program regularly issues RFP's in search of Science and Technology projects that strengthen Canada's ability to anticipate, prevent, mitigate, prepare for, respond to, and recover from serious threats or incidents to Canada.

- IRCC has been successful in winning two RFPs, receiving funding to innovate IRCC's program application processes, while increasing client convenience, program integrity and national security.

- The first project, entitled FASTER Privio combined the efforts of IRCC, CBSA, two universities and one private company. As planned, the project build the prototype of a mobile application, with eTA as the use case, that enabled the advance, remote, secure and private collection of information to enhance the screening of eTA applicants. Approved applicants receive a private and secure token stored on their smartphone to clear border processes. The prototype has been delivered on-time and on-budget, with project coming to an end in March.

- The second project, entitled Chain of Trust, combines the efforts of IRCC, CBSA, a university and three private companies, builds on the successes of FASTER PrivBio to build automated adjudication rules to continuously assess risks and triage applicants and travellers using the powers of predictive analytics. Project will start in April 2017 and will run for one year.

- Projects are prototypes. They do not use real data, nor are they linked to any GoC systems.

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FASTER-PrivBio Project - Benefits

Using the Electronic Travel Authorization Program (eTA) as a use-case, developed a smartphone App prototype that provides an innovative, mobile, end-to-end eTA application solution that accelerates processes for low-risk travellers and triages applications for manual adjudication (at time of application and at the self-service border kiosk).

- For the traveller
  o Convenience of using a smartphone, from time of application, to time of entry into Canada.

- For the GoC
  o Potential increase of public safety and national security:
    - Stronger applicant identity by early verification of ePassport and facial biometrics
    -
    - Reallocation of resources to higher risks applicants and travellers

- Privacy of personal information is built in the architecture.

- Although the prototype was build using the eTA, several IRCC programs could benefit from the concept.

- FASTER PrivBio uses technologies that already exist and, that are commonly used by consumers, businesses and governments around the world. Namely the smartphone and its camera.

- The project takes these technologies and combines them together to build an application that simplifies and accelerates the processing of low-risk travellers and triages applications for manual review, whether at time of application or at the border.

- For the traveller, the solution brings added convenience. Use of smartphones are widespread and keep on increasing in numbers and possibilities.

- For the Government of Canada, the solution increases efficiencies, public safety and national security.

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FASTER-PrivBio Project
FASTER Component

Prototype shows that the secure remote collection and verification of an applicant's biometrics and biographical data can be done at pre-travel stage. Smartphone capabilities can enhance risk based screening of immigration applications. While the Project focused on the eTA as the use-case, other IRCC programs could benefit from the capabilities and maybe extend lower risk program eligibility to more travellers.

- DESIGN OF SMARTPHONE APP PROTOTYPE
  - User friendly interface (drop down menus, visual aids, minimal data capture, etc.)
  - Benefits of smartphone Near Field Communication and Camera capabilities

- PRIVACY OF PERSONAL INFORMATION BUILT INTO THE APP ARCHITECTURE
  - No storage of personal data on mobile device
  - Secure transmission of personal data to servers

- CAPTURE OF EPASSPORT'S BIOMETRIC & BIOGRAPHIC DATA ENSURES DATA INTEGRITY

- STATUS NOTIFICATIONS AVAILABLE ON MOBILE APP

- SMARTPHONE QUICK RESPONSE CODE (▦) CONTAINING TRAVELLER INFORMATION AND ETA AUTHORIZATION TO BE USED AT BORDER SELF-SERVICE KIOSKS

OK, now how does this work? Well, basically, the solution has two components:
1. The application process (FASTER) and 2.
2. The Validation process at the border kiosk (PrivBio)

As it relates to the application process, the applicant:
- Downloads the APP to the smartphone from Google Store (Android based only for now)
- Creates his eTA Account
- Takes a picture of his/her ePassport Datapage
- Places the smartphone on the ePassport to transfert content of the chip to smartphone
- Takes a selfie
- Completes the eTA application by answering Program questions and make payment
- Information is packaged and securily transmitted to IRCC servers.

- The application is very easy to use, having gone through usability testing
- The protection of personal information was built into the solution. The smarthone does not store personal information, and the security of the transmission are at the forefront of technologies.
- Applicant biographic and biometric information is pulled from the passport chip, so limited chances of errors (program integrity) and keying is all done by applicant
-

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FASTER PrivBio Project
PrivBio Component

Prototype shows that the secure and remote storage of an individual's biometrics and biographical data and travel approval can be done at pre-travel stage. The private information stored on the smartphone can be used to verify a traveller's identity and travel authorizations at border self-service kiosks.

- PROOF OF CONCEPT - PRIVACY PRESERVING BIOMETRIC IDENTITY ALGORITHM
  - No facial templates on the smartphone
  - Biometrics cannot be reverse engineered
  - Encryption accounts for biometric variability

- PROJECT PROVES THAT THE VISION OF THE FUTURE IS POSSIBLE
  - Mobile device can become the travel document
    - At time of application: remote use of travel document & biometric
    - At border self-service kiosk: privacy preserving biometric & authorization
  - Physical book (ePassport) remains a needed companion
  - As it stands, the Smartphone App could complement existing processes for a meaningful segment of international travellers to enhance facilitation and security

---

- PrivBio is the second component of the solution. Basically, the component uses complex mathematical formulas to: store personal information, the facial biometric, the eTA number and passport information on the smartphone in the form in the form of a key. The smartphone and the ePassport is used at the border self-service kiosk.

- So how does it work. At the border self-service kiosk,
  - the applicant will insert his passport in a reader and tap his smartphone against another reader (similar to « tap and pay » at retailers such as Starbucks)
  - Kiosk will unlock content of chip and telephone
  - The kiosk will take a picture of the traveller and compare it to the ePassport and smartphone
  -

- Protection of private information was key throughout the project
  - No personal information is stored on the phone
  - Facial biometric cannot be drawn from phone

- Solution proves that convenience, privacy and security can exist together on a smartphone device.

Chain of Trust Project
Benefits
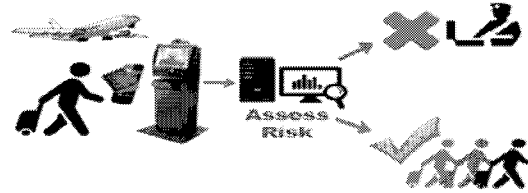
- FOR THE TRAVELLER
  - ➤ Faster processing and improved client experience for low-risk travellers

- FOR PROGRAM INTEGRITY
  - ➤ Increased likelihood that high-risk individuals will be flagged for scrutiny

- FOR INNOVATION AT IRCC
  - ➤ much-needed funding to advance predictive analytics

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Chain Of Trust Project
Components

Building on the successes of FASTER PrivBio, the Chain of Trust Project aims to enhance the prototype to:

1. COLLECT ADDITIONAL DATA EARLY IN THE TRAVEL CONTINUUM, INCLUDING:

   - Enable online submission of the E311 Declaration Form prior to arrival in Canada.

2. CONSOLIDATING ALL DATA COLLECTED ABOUT THE TRAVELLER THROUGHOUT THE TRAVEL CONTINUUM

3. DEVELOP A COLLABORATIVE PREDICTIVE ANALYTICS RISK ASSESSMENT BY IRCC AND THE CBSA

   - Each agency will develop their own predictive models to assess the risk posed by travellers.

   - IRCC's risk assessment during eTA (use case) adjudication will be shared with the CBSA and incorporated into their risk assessment.

   - CBSA will update its risk assessment as each traveller advances through the travel continuum.

   OPPB will focus on objective 3

Additional info upon check-in.
Additional info when Declaration Form filled.

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Next Steps

- **FASTER PRIVBIO PROJECT**
  - Present End-to-End Concept to CSSP Program Director
  - Complete Close-Out Reports

  - Suggest the App for pilot consideration within an IRCC Program

- **CHAIN OF TRUST PROJECT**
  - Work will occur during 2017-18
  - Project charter is finalized and currently in the approval process
  - Procurement activities with private-sector partners to be completed by April 1, 2017
    - ➢ OPP will receive $350K from the CSSP to manage the contract with WorldReach Software Corporation, responsible for the improvements to the smartphone App
    - ➢ The CBSA will manage contracts with the other partners
  - OPP will continue to work closely with the IPG and IRG during the development of risk indicators
  - A demonstration of the prototype is planned for early 2018

Meeting w Ravi   Date Jan 25, 2017

Like the PA, but no good tool to get scores
in front of officers w each application

To integrate into GCMS

Ravi   Do a pilot on small number of apps,
        on a sample of new apps

        ↳ Hubert and Ravi agreed   Plan w
          Go to BOC   David Cadeduch
                                         Julie Rémillard
                                         Karim Varani

        { for ~ 5 months to about 3 days
          ↳ done at same time for
            in Canada
          For overseas, spons done
          first then elig
So model may be better suited for in-Can.

Eventually, AI also us using PA to anticipate workload
based on segmentation of people in inventory

Lauren Foley is a manager in SIMB that could help w a pilot

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Date

New kit vs old kit : which fields?
→ new applicators since Dec should be a good guide.

Family Class → Tyler   Date Feb 27, 2017

OB570 triage rules   visa reqd vs exempt

Send chart of breakdown of 10 countries
in Rule 3

Best to choose rules where no likely Admiss issues

→ Rule 27: show breakdown by country

Can we merge 2 and 3: abstract from
Need country breakdown   open applic

If we lower threshold, what happens?
↳ How can tweak rules 2, 3 and 27

Page

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Data and Predictive Analytics: Opportunities for CIC

What is Predictive Analytics and why do we do it?

The term "predictive analytics" describes the process of discovering patterns in past behavior to predict the outcome of future events. It combines computer science, statistics and operations research to drive smarter decisions by extracting actionable insights from the vast quantities of data captured by government departments.

Predictive analytics helps prevent fraud and reduce waste.
Aside from the operational efficiencies gained, predictive analytics can be used to standardize decision making processes, increasing fairness and transparency.

Predictive analytics will reduce the labour intensity of application triaging and processing as well as minimize the time to a decision for a significant number of cases.

Projects under way (see below for all the details):

Predictive Analytics moves forward CIC's modernization agenda by supporting key initiatives such as Integrated Network Project, Electronic Travel Authorization (eTA), and Express Entry.

Progress to Date:

1- MONEY and People for Predictive Analytics:

N/R

We have money that will be temporary (some of Express Entry for example) and money that will be ongoing, for delivering projects and to establish an ongoing function in CIC so that models can be fully used by regular monitoring and improvement.

We have therefore a bit over 800,000$[1] for each of the first few years to establish the team and the function, and the ongoing funding is around 700,000$[2]. Of note though that the Integrated Network project is currently expanding beyond TR, and DPAT did not receive funding for work beyond TR and a few PR lines. The project and ongoing funding might change in the near future. The **team** was officially formed in March 2014, first with two people, now with 6.5 full time resources.

2- Projects we are working on and progress to date: (see the attachment for a full picture)

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[1] For the current projects
[2] Of note, the USA as well as other countries, has a budget of millions for the similar teams and functionalities.

Paper by DPAT (MJD and IB), Feb 10th, 2015. 1

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- Models for Automated triaging and for auto-assignment of <u>Express Entry applications </u>by December 2014 for phase 1 and for the Fall 2015 for Phase 2 of modeling (to rebuild with real express entry data) , for a roll out of a Predictive Analytics model in late spring 2016;

What that means is that we have work and models to develop until Spring 2018 for now, (pending IN Project confirmation of dates) and ongoing monitoring and maintenance of potentially up to 30 models (according LOBs).

Engagement and IM/IT:

<u>Predictive Analytics Working Groups:</u>
DPAT is holding bi-weekly meetings for each of the ongoing projects. The purpose of these working groups is to combine operational business knowledge and expertise with statistical analysis.

<u>Engagement of other departments and other countries:</u>

Predictive analytics is a fast moving technology and maintaining external partnerships is important to ensure that business objectives are met and that technology focused activities are aligned with the broader CIC modernization. We, OPMB-PMU-DPAT initiated and chair an Analytics Coalition, in a collaborative effort with 13 other government departments and the Privy Council's Central Innovation Hub. We have also engaged in conversation with   the UK (by CBSA LIO), with the Australian (directly); and we visited the US last year.

<u>Engagement and working with SIMB / IT:</u>

Functionality for changing business rules (the models) needs to be independent of GCMS releases, and be centrally modified by the program in order to control program risk or in order to manage workload. Just-in-time quality assurance will also be made available.

Opportunities for Success:

Decision making processes at CIC can be enhanced by using predictive analytics models, which offer the following benefits:

- Replaces rules and risk profiles based on subjective input and "gut" feelings with evidence based, data driven business rules.
- Increases operational efficiency by reducing the number of paper based, manual business processes.
- Improves the transparency and consistency of decisions across the CIC processing network.
- Decreases the effort required to do quality assurance.
-
- Enables triaging and organizing application workload for optimal throughput.
- Can be used as legal evidence to support CIC.

Success is measured in terms of the business value delivered: faster application processing, consistent decisions and optimized business processes. Business user satisfaction and an improved client experience are also key success factors. Long term success will be evidenced by a pervasive culture of analytical thinking at CIC, mathematically sound practices, and the capacity to participate with other government departments on predictive analytics projects. Key aspects of successful projects as it relates to Data and Predictive Analytics:

1. Simplify the concept of predictive analytics for business users and managers.
2. A consistent process for collaborating with the business stakeholders
3. Specific business outcomes for predictive analytics work
4. Adequate IT support
5. Proper communication of the results of predictive modeling to business stakeholders
6. Having timely insights from predictive models in front of the business staff that can best use them
7. A closed-loop feedback process for improving and updating predictive models.
8. Executive endorsement of the results and for data driven decision making

Predictive analytics projects have seven main phases:
1. Collection of Data & Business Requirements
2. Analysis of Preliminary Data
3. Development of Predictive Models
4. Validation of Predictive Models
5. Statistical modeling of risk/complexity scoring
6. Implementation of Predictive Models
7. Monitoring and Maintenance of Models

SK or Hubert:

Predictive analytics have **proven value** in private industry and government

Predictive Analytics are **a key piece of the modernization strategy**
DPAT is working closely with partners: SPO, PID and OMC

CIC is at the very beginning of using predictive analytics
We are catching up on other countries (USA and Australia for example) and other
departments

Expectations need to be set carefully
Predictive analytics can be transformative for an organization,
but it takes a long time to put everything in place

Analyse prédictive – Aperçu

Qu'est-ce que l'analyse prédictive et en quoi est-elle importante?

L'analyse prédictive à CIC

Modélisation de l'analyse prédictive pour Entrée express

Entrée express – Exploration des données

L'avenir (phase 2) : Triage automatisé

Prochaines étapes

Annexes 1-2 : Leçons tirées des autres ministères et gouvernements étrangers

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MJ opens and explains definition and how it works. Also talk about concrete benefits in any business doing predictive analytics (Walmart, for example, or Google, that both use that now in their business to save money, profile their consumers and improve resource allocations)

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:

• Increasing processing capacity

• Facilitate program integrity exercises
• Deliver optimal client service

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MJ:

Read the deck bullets and insist on OUTCOMES:

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MJ:

Team is new.
When did we (CIC) get into predictive Analytics:
TR MC and Express Entry, this year (2014) were the first projects that got approval to do predictive Analytics.
TRMC: 500K app in FTE for
Express Entry : 450K in O&M and 3 FTEs
ETA : 2 FTEs

Insist on Predictive Analytics capacity building will not happen overnight. Predictive Analytics take time to implement.
OTHER COUNTRIES and Other Departments have done this for a few years now: **proven value to achieve better allocation of resources.**
Building partnerships is key;

Passport is certainly a key one we need to work with.
And We say CIC here but a few words on passport:
-Passport has been doing long term forecasting for years in order to forecast volume of work by office; and that is related to the funding model of passport, i-e revolving funds.

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Marie-Josée:

-Partners and clients:

-OPS partners, such as OPMB-PMU, OMC-PRPD, OMC-PID, IR, CPR, and SPO.

-Historical data:

FSW: **Total number of valid records consist of 155,665** applications
Total number of **fields** is **122** unique fields
Dates covered (final decision dates) are from **2007-01-01** to **2008-02-27**

PN:**Total number of valid records consist of 111,060** applications
Total number of **fields** is **122** unique fields
Dates covered (final decision dates) are from **2007-01-02** to **2014-08-18**

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CEC: Total number of valid records consist of 25,058 applications (GCMS only)
Total number of **fields** is **122** unique fields
Dates covered (final decision dates) are from **2011-07-16** to **2014-08-15**

Concrete benefits in any business doing predictive analytics (Walmart, for example, or Googles, that

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:

•Increasing processing capacity

•Facilitate program integrity exercises
•Deliver optimal client service

Data Analytics: out reach

Data Analytics Working Groups
predictive analytics demands tight collaboration with partners and the business
We started the WG in collaboration with PID. We co-chair.
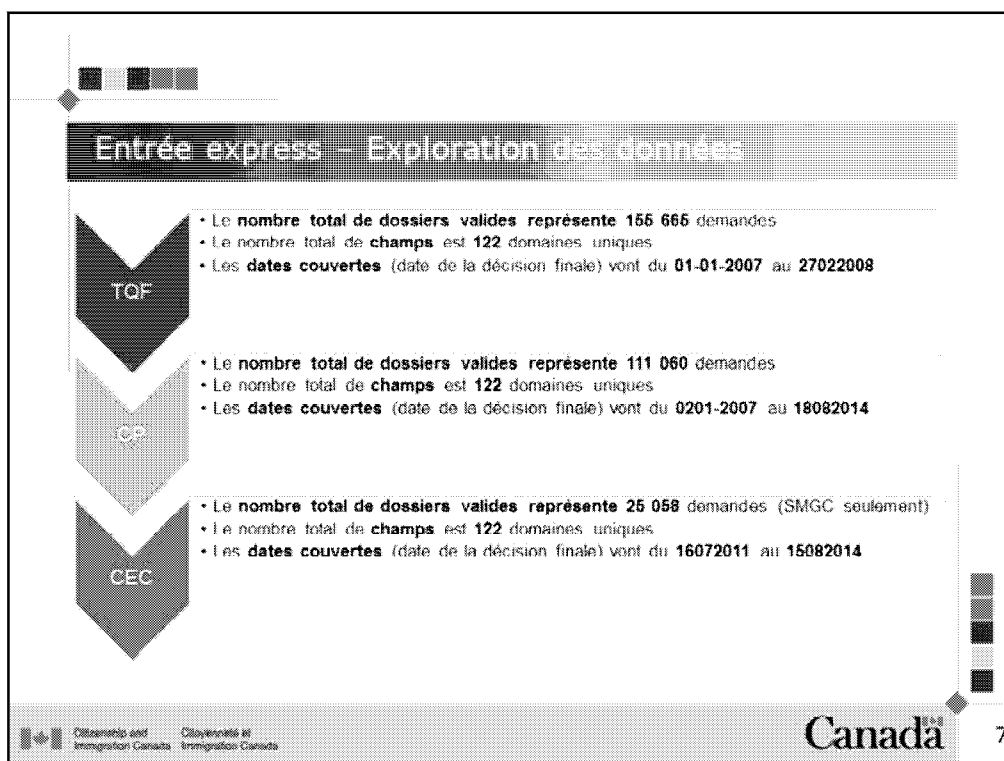
Data Analytics Coalition
Great forum for sharing ideas and best practices as predictive analytics is relatively new to the federal government
Similar goals – workload distribution
Common challenges – change management, setting users expectations, poor data quality

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For **FSW**, DPAT analyzed data for FSW before and after MI. As a result, before MI data was chosen for FSW. This decision was based on business knowledge and opinion on which cases should be included in the sample in the way that there would not be any lost in representativeness of our future population of applications, while preserving the quality of the data set. The fact that Express Entry does not have MI restrictions is also consistent with this choice of pre-MI time period for modeling.

For **PN**, data was analyzed for GCMS and CAIPS separately due to some missing values problem.   since both sets of data yield the same acceptance rate and adding more applications to build the model results in a higher degree of freedom leading to increased robustness. Thus helping to ensure that the model performs as expected (i.e. is not over-fitted).

For **CEC**, WG suggested that DPAT use only GCMS data from 2011 to 2014-07-04 (final decision date) given all the missing values in CAIPS.

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Marie-Josée:

Scores and models are not everything: other rules in GCMS will be combined with the SPSS models scores so that triaging is automated and as accurate as possible.

The placement of the business rules might change after we have come up with a Solution (IT) as this is just tentative for now.

Complexity will be added in the future to the Predictive Models, in order to do complete complexity and risk-based triaging.

Quality Assurance is a random selection of XX% of cases for QA, assigned to QA group.

Workloads Distribution: Each bin can be assigned to officers according to operational requirements, expertise, levels, etc.

Triage Model Validation: A random selection of cases from bin #1 and # 2 will be assigned to officers at superior levels to ensure that:

Higher ranking officers remain exposed to all types of case.

Senior officers can continuously validate the Triage model.

Experienced officers can confirming that cases were effectively assigned to the right bin by the Triage model.

Experienced field officers can detect errors in the Triage model.

Experienced field officers can provide intelligence to centralised offices and HQ in order to improve and rafine the Triage model.

Note:
For FSW, PN, CEC was used C5.0. algorithm to develop the models. Each of these LOB has different output for probability bins.

Marie-Josée:
Details:
•It is anticipated to restart WG after receiving Express Entry data.
•need to validate model and allocation, but any feedback soon in the process will be appreciated.

Ravi or David to close the deck?

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For all departments, the end goal is better allocation of resources.

Analytics Coalition
Chaired by the DPAT
Share analytics best practices with OGDs who are working on analytics projects
Most have a similar goal: improve workload distribution.
The 4th meeting was on May 28, 2014

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Touch Base on Analytics Work and Transition Meeting Notes

May 25, 2015 from 11-12 am

Boardroom-KENT-7-95

Attendees

- Marie-Josée Dorion – DPAT
- Darren Goodyear– DPAT
- Somaieh Nikpoor– DPAT
- Elena Tipenko– DPAT
- Olga Anglinova - DPAT
- Derek Pickell– PID
- Fawad Popalyar– PID
- Jae-Won Chung – SPO

- Marie- Josée mentioned about SPO providing trend analysis/reports/findings (according to ID 258 from DPAT project's schedule)
- DPAT to revise TR (TRV, TFW, IEC, VR-extension, Student) with addition of new derived variables and flags
-

- Jae-Won Chung mentioned that suggested Go Live date for TR might be November, 2016 (not January 2017 as in DPAT schedule)
- There are no concrete deployment days for PR and Citizenship besides the years - 2017 and 2018 correspondingly (no costing yet and uncertain number of applications for PR)
-
-

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Analytics Coalition Meeting November 22, 2013 Citizenship and Immigration Canada - Meeting Minutes -	
In attendance: CBSA, RCMP, ESDC, CIC	
1. **CIC (Strategic Projects Office) overview of ETA initiative**	• Scheduled launch of April, 2015 • Limited data on people that will be screened under ETA 1.0 as they are from non-Visa required countries. Attempting to add some level of risk assessment to ensure as rigorous of screening up front as possible. • Will be collecting passport numbers for the first time under ETA. **CBSA** communicated that • **Question:** how do you test the system for accuracy? **Response:** Other systems can assist in overall machine learning. Other efforts, such as dedicated resources, will also be devoted to quality assurance. • **CBSA:** random screening also aids in machine learning. **Action item:** Strategic Projects Office to share Australian model of ETA.
2. **CIC Presentation & Discussion**	• In preparation of ETA, looking at data for visa exempt countries from 2008-2012 for workers and students (visa exempt countries), which amounts to over 500k records in total with 41 fields for each record. Used SPSS to select only workers, which narrowed results to 300k. Have to deal with outliers and missing/invalid data in 300k records. Conduct correlation analysis between variables in SPSS and establish indicators that SPSS believes are leading to the decision. Data has to be boosted or begged in order to re-weight for more accuracy. • Autoclassified results which took average of two results. One of the best features is that is produces decision trees, allowing for very fluid clustering of data inside the model. • ‘ I • This should improve as business rules are improved, more recent data is used, model manipulation in strengthened, and from consulting with subject matter experts. • Analytics for second phase of ETA (visa required countries) should be easier as there is already information on them as a result of the visa requirement. • Second ETA will have subpopulations, such as low risk travelers from high risk countries.

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Discussion/rountable	•
	• **CIC:** model score seems to be more frequently occurring probability score on the records...is this similar in other areas?
	• **CIC:** Do colleagues score outside or inside of production system?
	• **CIC:** How are indicators updated?
	• **CIC:** When modeling, you need business experts and rules to increase effectiveness of model.
	• **CIC:** Cache data in order to not overwhelm the system.
	•
	•
	•
Next Steps	• Ivan to circulate distribution list of group.
	• Next meeting in January at CIC, where the

BACC Projects

IEC – International Economic Class

TR Extension

triage

Automated Workload Distribution

SPO – Strategic Projects Office

ETA

SPO – Strategic Projects Office

For countries where visa are not required now

April 2015 soft launch, October 2015 hard launch

Risk of public backlash

Need 72 hour processing time

Data from CBSA required

eTraveller

for Visa required countries

rollout after ETA

manage political irritants, rollout globally

Expression of Interest (EOI) – January 2015

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Blended approach

Controlled intake

Universal Points Grid

Pool opens October 2014

Reduce processing time

Temporary Resident (TR) automatic decision making

Volume increasing

TR – worker, student

TRP – free pass from the minister

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Data and Predictive Analytics Team
(DPAT), PMU/ OPMB

Data and Predictive
Analytics at CIC
Communication paper

Prepared by the Data and Predictive Analytics Team (DPAT) in
PMU (OPMB)
4/30/2014

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Data and Predictive Analytics at CIC

There are several modernization initiatives underway at CIC to support a faster, more efficient and cost effective processing network. Data analytics are a key technology component underpinning these efforts.

What are data and predictive analytics?

The term *data analytics* refers to the practice of using a variety of statistical techniques to support business processes and organizational outcomes. *Descriptive analytics*, also known as Business Intelligence, provide a numeric view of the organization and operational activities via aggregate reports and dashboards. *Analytics* in this sense describes exploring data, making sense of historical events and discovering trends. This is the foundation for data analytics.

Data analytics also encompasses using data to optimize and guide business decisions. Some of this work focuses on understanding the likelihood of an event happening in the future, which is known as *predictive analytics*. These are data driven insights that infer future events based on quantified historical behaviour. Predictive models are developed using statistical analysis and can be built with the capacity to adapt to changing conditions reflected in the data.

Predictive analytics can take the form of a report or graphic to provide guidance to business users. Often the analytics are embedded into the business rules of an application, serving to optimize technology enabled business processes without input from business users.

How do predictive analytics work?

With the aid of specialized software, a skilled data modeller builds predictive models that accepts data inputs and returns the likelihood of outcomes based on variables found in the data. Clarity around the business context produces effective results. The predictive models define a mathematically sound probability of outcomes. Theoretical measures, such as accuracy, precision and sensitivity are used to compare different models, but ultimately, the results are judged from a business perspective. While the future will always remain uncertain, even a small degree of foresight can have a huge impact in optimizing business decisions.

Data analytics in the private industry

Data analytics have been in use in industry since the widespread adoption of relational databases in the 1980s. The digitization of commerce and recent advances in database technology have allowed companies to collect more data than ever, accelerating the use of data analytics. The results have been dramatic for companies that have chosen to let data analytics permeate their corporate culture. A well known example is Google, which offers many examples of data driven decision making at all levels of the organization and embedding analytic algorithms in its products. Google was founded in 1998, but it is

one of the fastest growing companies in history, reaching a market capitalization of $400 billion in early 2014.

User Experience on the Web

An example is **Google Instant Search**, which returns search results as the user is typing in the keywords. Google uses algorithms based on the user's location, search history and other variables to return search results before the user has even finished typing the search query. This enhances the user experience with Google's core technology, encouraging the user to return repeatedly to use the Google search engine and be exposed to the advertising that Google sells.

Fraud Prevention

An example of using data analytics for loss prevention can be found in the **financial industry**: if a credit card user makes purchases inconsistent with the historical use of the card, then the bank is alerted to these possibly fraudulent transactions. The card owner is then contacted to ascertain the validity of the transactions. This prevents loss for both the bank and the consumer.

Data analytics in government

Following the examples found in the private industry, governments are leveraging the same data analytics technology to reduce costs, mitigate risks and promote operation effectiveness. There are several examples relevant to CIC:

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Meet the DPAT: Data & Predictive Analytics Team

The DPAT is a new team in OPMB, focusing on areas where predictive analytics can have a significant and timely impact at CIC.

Optimized case workload distribution will maximize the use of application processing skills at different levels, thus increasing processing capacity.

Two projects are underway, one with **Express Entry (EE)** and the other with **International Experience Canada (IEC)**. This work is a key component of the **Integrated Workload Distribution (IWD)** initiative for the Temporary Resident (TR) line of business. Predictive analytics will reduce the labour intensity of application triage and processing as well as minimize the time to a decision for a significant number of cases. A third project, still in its infancy, will help the Centralizes Processing Region (CPR) office consistently triage FC4 and CAN+ applications.

What data and predictive analytics is not

Forecasting will take a benchmark measure and then add estimates for the future period to calculate an expected figure. This is useful for calculating the required capacity to deal with application demand. However, it is different from predictive analytics because a predictive model will test variables across many dimensions to calculate the likelihood of a scenario based on the relationships between the variables. In contrast, a forecast extrapolates a historical trend to predict future demand or output.

OLAP cubes are a Business Intelligence (BI) technology that is often described as "analytics" or as an "analytical reporting" solution. The cubes are different than reports because they allow business users to make rapid ad-hoc queries across many dimensions (slice and dice data) and to move from summary to detail level data with ease. The cubes can do regression analysis and forecasting, but for most cases, the algorithms are too simple to produce useful results.

Data mining is the search for hidden patterns and relationships in data sets. It helps analysts recognize significant facts, exceptions and anomalies that might otherwise go unnoticed. Some of the data modeling work necessary for predictive analytics uses data mining techniques, but data mining as a practice does not confine itself to results that are predictive in nature.

Analytics are not a shortcut for validating data or casting doubt on reports from other sources. Statistically sound techniques exist for verifying data, but this is very different from predictive modeling.

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Data Analytics Glossary

Accuracy – For a predictive model, accuracy is the ratio of correct predictions to the number of cases evaluated. This is a useful way of comparing models during development, but it is only one criterion among many in selecting the best model to solve a business problem.

Advanced Analytics – A synonym for Business Analytics, often used in reference to new technology.

Big Data – A volume of data so great and unstructured that it cannot be stored, manipulated or analyzed using traditional relational database technology. Because of this volume, the analytics can lead to more interesting results than with smaller and less comprehensive sets of data.

Business Analytics – Data analytics that support specific business decisions or organizational outcomes.

Business Intelligence (BI) – Also known as descriptive analytics, BI describes the reports and infrastructure required to present data in a format understandable by business users .

Data Analytics – Employing a variety of statistical techniques and software tools to explore and to extract value from raw data.

Data Mining – Algorithmic discovery of previously unknown characteristics or patterns in a data set.

Data Warehouse – A repository for data from operational data stores and other diverse sources. In a data warehouse, the data is transformed by applying business rules and the database is optimized for query and reporting purposes.

Forecasting – Predicting a future outcome based on the extrapolation of a historical trend.

Machine Learning – Often used as a synonym for Data Mining, but refers specifically to algorithms that evolve themselves based on conditions observed in the data.

Predictive Analytics – Data driven insights that infer future events based on quantified historical behaviour.

R – An open source programming language for statistical analysis and data visualization. Popular in academia and used by the DPAT.

Relational database – A common database technology, based on the concept of data stored in tables made up of rows and columns, with the tables related to one another.

SPSS – IBM Software used for statistical analysis at CIC. SPSS integrates well with IBM Cognos.

SQL – A programming language for relational databases.

Structured data – Numeric or text values that fit into columns and rows; metadata exists to describe the data.

Unstructured data – Videos, photos, sounds, text or anything that has been captured and stored digitally; metadata does not exist and would be onerous to define.
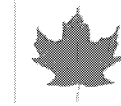
CSSP Funding for Predictive Analytics

Operations Planning and Performance Branch
Business Research, Intelligence and Analytics Directorate

February 2017

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Canada

Key Points: Predictive analytics project funded by CSSP

- OPPB has won a grant from the Canadian Safety and Security Program (CSSP) to undertake a collaborative innovation project entitled "Chain of Trust".

- The project brings together federal, industry and academic partners to build a prototype of a risk assessment and passenger screening system for air travellers coming to Canada.

- OPPB will receive **$237,000** in 2017-18 to use predictive analytics to develop risk indicators for the Electronic Travel Authorization Program (eTA).

- The project builds on a previous CSSP-funded project titled FASTER-PrivBio.

- IRCC is the lead agency on the project.

What is the Canadian Safety and Security Program (CSSP)?

The CSSP is a federally-funded competitive granting program administered by Defence Research and Development Canada (DRDC). The program funds government-led R&D projects in collaboration with response and emergency management organizations, non-governmental agencies, industry, and academia.

Risk assessment will apply to all air travellers coming to Canada, which includes returning Canadians.

We are the lead agency on this project. Other partners include the CBSA, three companies and the University of Ottawa
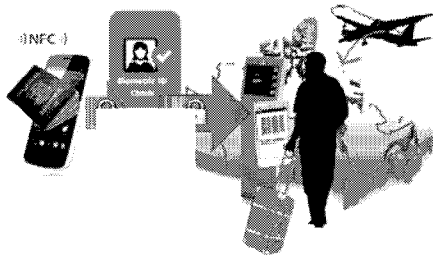
Background: The FASTER-PrivBio project

- In 2015-16, OPPB was awarded $60,000 by the CSSP for a project called FASTER-PrivBio, which involves the CBSA, a private company and two universities.

- The project successfully developed a prototype smartphone app that provides an innovative end-to-end eTA application and border management screening process.

- It leverages the capabilities of the ePassport, smartphone technology, biometrics and self-service kiosks.

- It also uses innovative encryption algorithms and Privacy by Design Principles to ensure the security of corporate and personal information

- This project is slated for completion in March 2017.

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The Chain Of Trust project

Building on this success, the Chain of Trust project aims to develop a prototype which will:

1. Collect additional data early in the travel continuum, including:

    • Enable online submission of the E311 Declaration Form prior to arrival in Canada

2. Consolidating all data collected about the traveller throughout the travel continuum.

3. Develop a collaborative predictive analytics risk assessment by IRCC and the CBSA.

    • Each agency will each develop their own predictive models to assess the risk posed by travellers

    • IRCC's risk assessment during eTA adjudication will be shared with the CBSA and incorporated into their own risk assessment

    • CBSA will update its risk assessment as each traveller advances through the travel continuum.

OPPB's work will focus on objective 3

Additional info upon check-in.
Additional info when Declaration Form filled.

Benefits of the Chain of Trust project
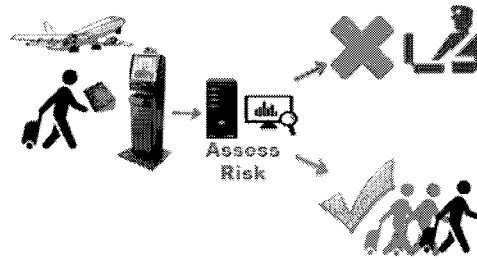
- For the traveller:

  ➤ Faster processing and improved client experience for low-risk travellers

- For program integrity:

  ➤ Increased likelihood that high-risk individuals will be flagged for scrutiny

- For innovation at IRCC:

  ➤ The project provides much-needed funds to advance predictive analytics

Next Steps

- Work will occur during 2017-18.

- The project charter is finalized and currently in the approval process.

- Procurement activities with private-sector partners will begin shortly, with the goal of having contracts in place by April 1, 2017.

  - ➤ OPPB will receive $350,000 from the CSSP to manage the contract with WorldReach Software Corporation, responsible for the improvements to the smartphone app.

  - ➤ The CBSA will manage contracts with the other partners.

- OPPB will continue to work closely with the IPG and IRG during the development of risk indicators.

- A demonstration of the prototype is planned for early 2018.

CSSP Funding for Predictive Analytics

Operations Planning and Performance Branch

Business Research, Intelligence and Analytics Directorate

February 2017

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OPPB's work will focus on objective 3

4

Benefits of the Chain of Trust project

Assess Risk

- For the traveller:

  ➤ Faster processing and improved client experience for low-risk travellers

- For program integrity:

  ➤ Increased likelihood that high-risk individuals will be flagged for scrutiny

- For innovation at IRCC:

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5

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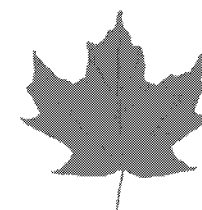
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Predictive Analytics, Business Rules, and

BOC – For Information   Date – September 14, 2015

Presented by: Integrated Network Project, OMC

Introduction

-

-

- This presentation explains – at a high level – how predictive analytics work and how CIC will leverage it

Predictive analytics – what is it?

- One Definition: "Predictive analytics is the process of discovering patterns in historical data and behaviours to infer the likelihood of future events and to predict probable outcomes"

- More simply, predictive analytics looks at how systems - or people - behaved in the past and uses the information to build a model to predict future behaviour

- Predictive analytics is widely used to model complex systems. Familiar examples include forecasting the weather, predicting the performance of sports teams, and suggesting interesting Netflix titles based on your viewing history.

Q: What is Predictive Analytics?

A: "...The power to predict who will click, buy, lie, or die. Predictive analytics is the technology that learns from data to make predictions about what each individual will do—from thriving and donating to stealing and crashing your car. By doing so, organizations boost the success of marketing, auditing, law-enforcing, medically treating, educating, and even running a political campaign for president."

Eric Siegel, author, former Columbia University professor, and founder of *Predictive Analytics World*

Predictive analytics vs. more traditional analytics

- Answers the Question "What's happening right now?"
- Dashboards and other real-time monitoring

- Answers the Question "What might happen in the future?"
- Business insights and predictive models

- Answers the Question "Why did it happen?"
- After action reports, summaries, etc.

- Answers the Question "What happened?"
- Standard and ad hoc reports
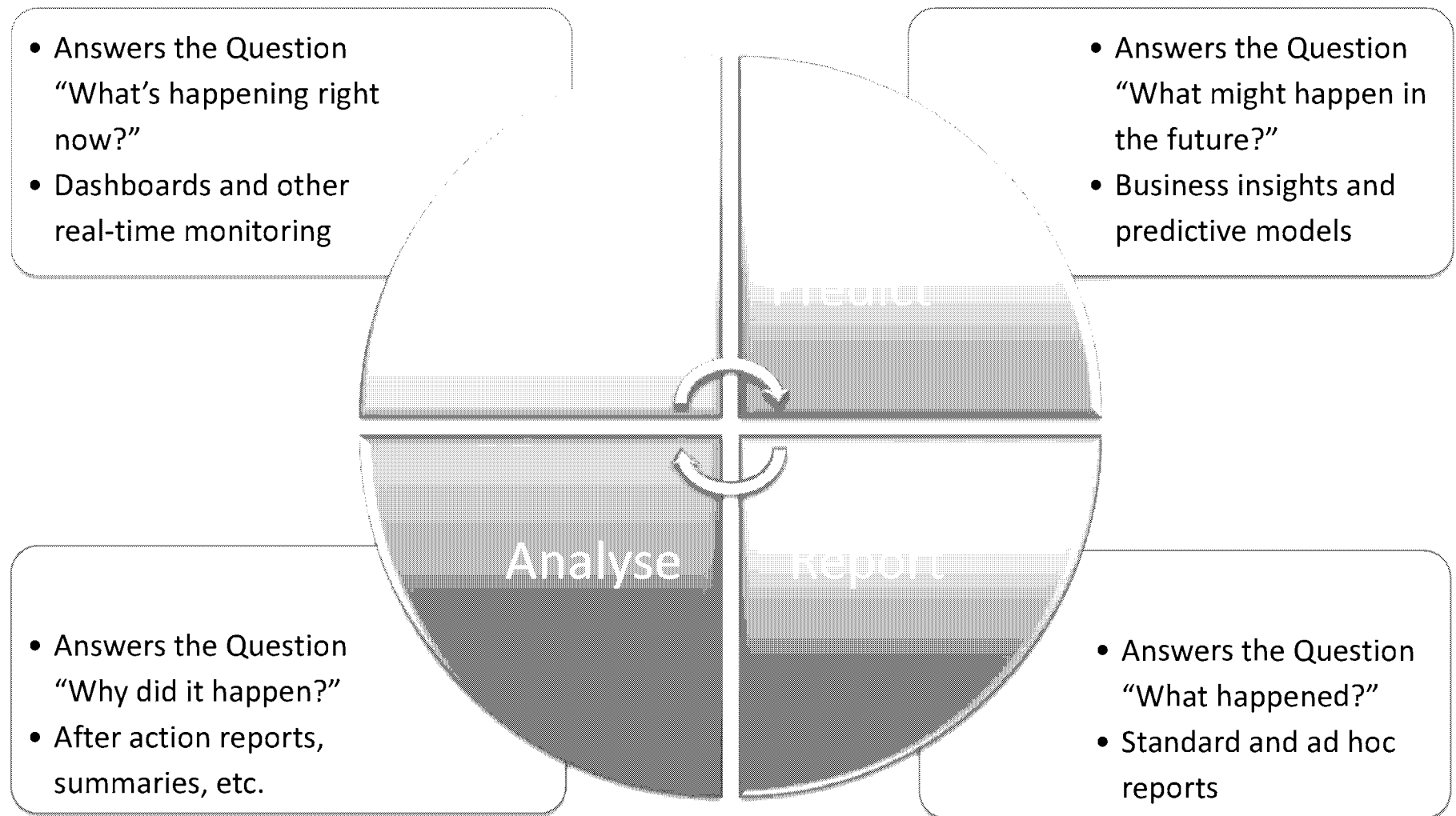
Predictive analytics – how does it work?

- Effective predictive analytics is a blend of data analysis, statistical modelling, and business intelligence

- Data scientists use powerful computer-based tools and statistical methods to sift through massive amounts of data to discover relationships, some of which will be obvious to business experts and others which may be completely new

- Business experts provide the background knowledge and experience to ground the model in reality by identifying areas where the data may be flawed, or business realities that might "tilt" the model in ways that data alone might not explain

- Data experts and business experts must work together to develop useful predictive models

Q: Does Predictive Analytics deal primarily with correlation or with causation?

A: "Correlation. Causation is an elusive thing to establish, and you don't necessarily need it in order to predict well. If we see the correlation that early retirees have higher health risks, we'd like to know why – but we don't actually need to know why in order to make use of that information. Instead, early retirement becomes one factor to consider when determining whether to prioritize a patient for additional screening or other prevention-oriented activities."

Eric Siegel

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Predictive analytics – a success story

- Weather forecasting is an example of gains made as a result of predictive analytics

- Weather represents a perfect arena for analytics
  - Data on weather is fairly easy to obtain
  - Data on outcomes is also easy to obtain; if we predict that it will rain tomorrow, and it doesn't, then we will obviously know that our prediction failed

- Weather prediction models were once quite inaccurate, even for next-day forecasts

- We are now able to predict local weather more than a week in advance with high levels of accuracy

- What changed?
  - Advances in technology, like satellites and doppler radar, have given us access to far more high quality data
  - Advances in computing allow us to run more complex models in reasonable times
  - Advances in our understanding have allowed us to build more accurate models

- What was once an inexact process has become routine and dependable

Predictive analytics – potential failure points

- Predictive models take historical data and extrapolate from it
    - Models cannot predict random developments such as natural disasters or regime changes
    - Models work with the data they are given
        - If the data is wrong, the model will be broken
        - If the data biased, the model will be biased
        - If key data is missing, the model will be flawed
- For example, if we currently streamline processing for a group of applicants then the data will "teach" the model to do the same
    - If we *shouldn't* be streamlining processing for that group (e.g. if there is an undetected program integrity issue) the model will perpetuate our error
- Humans can be prone to these failings as well

Question: Will there ever be a black President of the United States?

Data for model (2008): There have been 43 US Presidents, and they have all been white

Model prediction in 2008: It is highly unlikely that there will ever be a black President

When Barack Obama is elected in 2009 that prediction became demonstrably false

A more useful model would have included demographic, employment, and integration data to show American societal evolution – but the data would need to be available and the data experts would have had to provide it to the model

Predictive analytics – mitigating the risks

- Models cannot be trusted unconditionally

    – As conditions evolve or unexpected events arise, even the best models may drift out of alignment

    – Applicants and consultants may learn to "feed the model" by showing it what it wants to see, leading to program integrity risks (a risk for human decision makers, as well)

    – Some applicants have unique situations which a model cannot account for

- Risk Mitigation:

    – Before implementation, models must be tested against real applications to ensure they are working as designed

    – Post-implementation, models must *continue* to be tested to ensure that they remain valid

    – New data sources, especially data on outcomes (e.g. entry/exit information) must be actively sought out and integrated into our models

    – New predictive models can also be built to mitigate risks once we have better data – for instance, once we have entry/exit data we could design models which would predict whether or not particular applicants were likely to over stay

Predictive analytics modelling at CIC

- At present, OPMB's Data and Predictive Analytics Team (DPAT) is working with business experts to build predictive models for select lines of business (eTA, Students, TRV's, Express Entry, etc.)

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- No model is perfect

  - In the private sector, a predictive model which delivers a correct result more than 80% of the time is considered to be very effective

  - CIC's models are performing at better than industry standards in testing against historical data, but have yet to be tested in the field

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Business rules – what are they?

- ## Predictive analytics deals in probabilities and likelihoods, but business rules are absolutes

- ## A business rule is usually represented by logical statements

  - ### IF it is raining AND you are outside THEN open your umbrella

- ## Business rules can be very simple, or they can address a number of variables

Some examples of common business rules:

- Different lines of business are processed in select offices (**IF** line of business = "x" **THEN** send the application to office "y")

- Applicants are also differentiated by their characteristics, like their country of citizenship (**IF** country of citizenship = "x" **THEN** send the application to office "y")

- Triage criteria are used to identify complex clients in many lines of business (**IF** the applicant has known admissibility concerns **THEN** flag the issue to an officer for review)

- Triage criteria may also be used to streamline files in some programs (**IF** the applicant fits the criteria **THEN** send their application to the CAN+ stream)

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Questions to be answered

Annex 1: How DPAT develops a model

Collect Data and Business Requirements

Conduct preliminary Data Analysis

Develop Predictive Models

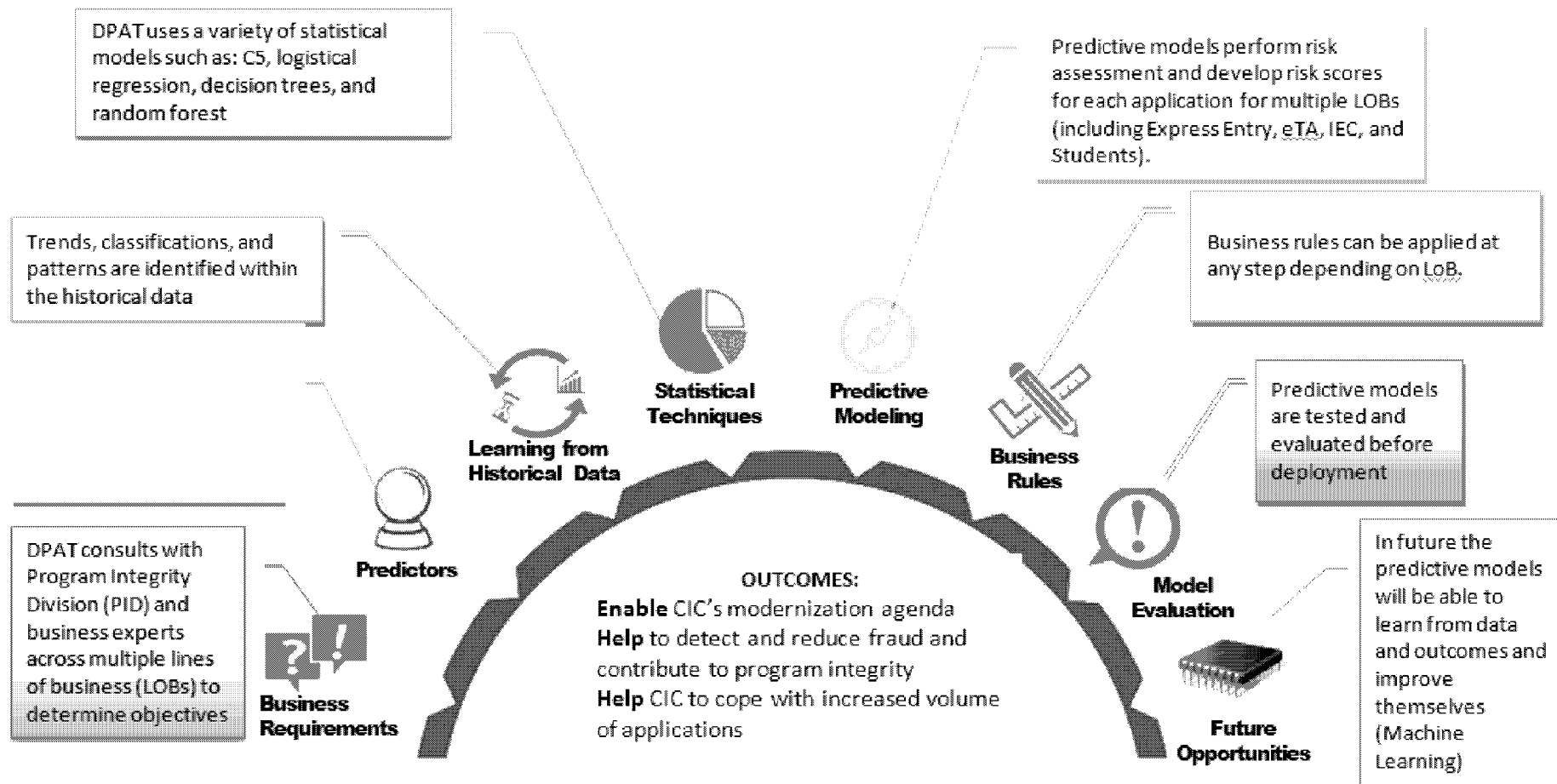Validate Predictive Models

Conduct Statistical modeling of risk/complexity scoring

Implement Predictive Models

Monitor and Maintain Models

Annex 1: How DPAT develops a model (continued)

DPAT uses a variety of statistical models such as: C5, logistical regression, decision trees, and random forest

Predictive models perform risk assessment and develop risk scores for each application for multiple LOBs (including Express Entry, eTA, IEC, and Students).

Trends, classifications, and patterns are identified within the historical data

Business rules can be applied at any step depending on LoB.

DPAT consults with Program Integrity Division (PID) and business experts across multiple lines of business (LOBs) to determine objectives

Predictive models are tested and evaluated before deployment

In future the predictive models will be able to learn from data and outcomes and improve themselves (Machine Learning)

Statistical Techniques

Predictive Modeling

Learning from Historical Data

Business Rules

Predictors

Business Requirements

OUTCOMES:
Enable CIC's modernization agenda
Help to detect and reduce fraud and contribute to program integrity
Help CIC to cope with increased volume of applications

Model Evaluation

Future Opportunities

DPAT - OPMB

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BRIA

Predictive Analytics and Forecasting Unit

Functions	Predictive Analytics	Forecasting	Outreach
Activities	❑ ❑ Develop predictive models for workload distribution ❑ Use data mining to identify risk indicators for Program Integrity ❑ Run simulations to test business rules proposed by LoB ❑ Experiment with new data sources (e.g., socio-economic indicators) ❑ Work with SIMB to deploy PA models in real time	❑ Develop forecasting models for all LoB except PR ❑ Generate/revise forecasts according to frequency and level of detail requested by LoB ❑ Assess sensitivity of forecasts to each driver (e.g. exchange rate) ❑ Run complex 'what if' scenarios	❑ Consult LoB to assess their needs and offer services ❑ Sollicit input from LoB experts on data issues and model results ❑ Provide feedback to OPMB colleagues on data quality and governance issues ❑ Facilitate interdepartmental sharing, notably through Analytics Coalition ❑ Maintain dialogue with SIMB on IT needs. ❑ Hold workshops to sensitize IRCC staff about PA
Skills	✓ Expertise in predictive modelling techniques ✓ Data interpretation and manipulation ✓ Expert skills in SPSS, R, Python and Excel ✓ Problem solving ✓ Understanding of operations ✓ Understanding of operating procedures ✓ Attention to details ✓ Link to business strategies ✓ Ability to learn new technologies	✓ Expertise in time-series forecasting techniques ✓ Data interpretation and manipulation ✓ Expert skills in SAS and Excel ✓ Problem solving ✓ Understanding of operations ✓ Attention to details ✓ Ability to learn new technologies	✓ Client relations and networking ✓ Presentation and communication skills ✓ Understanding of operations ✓ Understanding of operating procedures ✓ Link to business strategies ✓ Project management ✓ Data interpretation

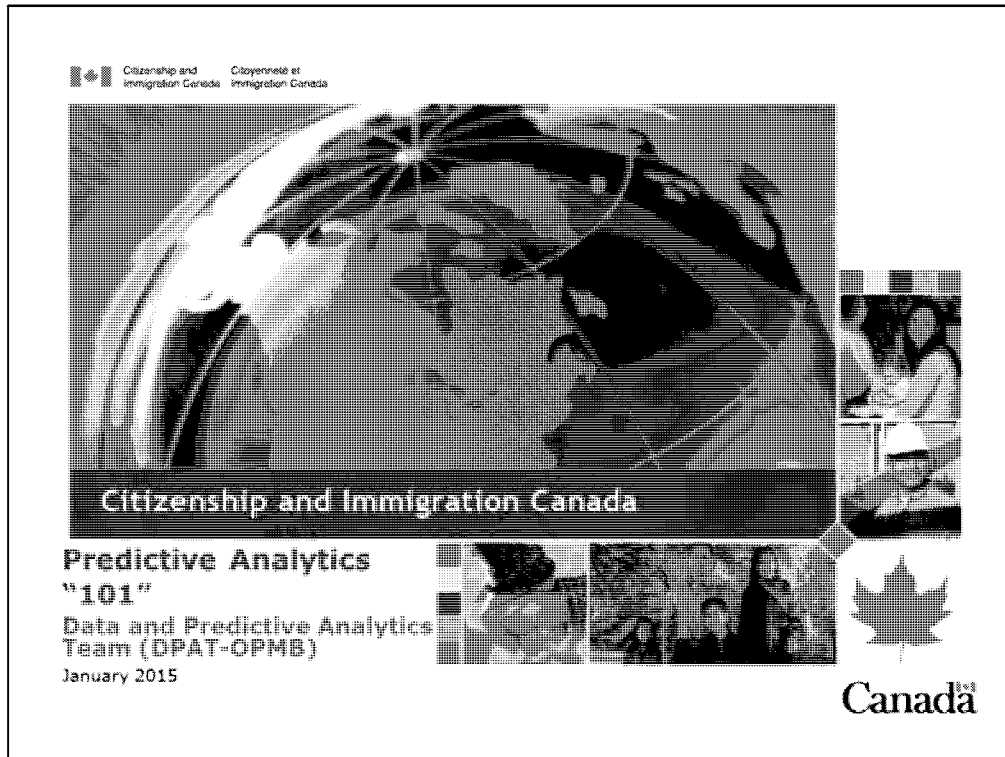# PAF Outcomes - Support for Decision Making

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- Assessed accuracy of various business rules proposed by Program Integrity
- Developed framework for workload optimization using Simplex algorithm
- Enhanced Passport forecasting models by incorporating new drivers (e.g. exchange rate)
- Produced monthly and annual forecasts for Passport, by LoB, office, and nationally
- Developed new models and produced annual forecasts for Temporary Resident visas, by region of origin:
  - Student visas and extensions
  - Visitor visas and extensions
  - Work permits and extensions
- Applying data mining to discover risk indicators of passport identity fraud
- Plans to develop forecasting models for additional LoB, starting with Citizenship and PR card

PAF Outcomes – Outreach

- Held a dozen Working Group meetings with LoB experts to:
  - Present data trends
  - Sollicit input on model development; and
  - Present initial model results.
- Working with SIMB to define business requirements for real-time deployment of models
- Developing a change management strategy for PA based on attitudes uncovered during five focus groups involving more than 30 IRCC employees.
- Held bilateral meetings with various branches of IRCC to raise awareness of PA
- Hosted several meetings of the Analytics Coalition to foster knowledge sharing among analysts from a dozen federal departments
- Led cost-benefit analysis of PA to support business case for real-time deployment
- Developing dashboard for TRV model to showcase the model's capabilities and potential efficiency gains for IRCC
- Upcoming "PA workshops" to sensitize IRCC employees to PA

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Predictive Analytics "101"

Data and Predictive Analytics
Team (DPAT-OPMB)

January 2015

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Predictive analytics have **proven value** in private industry and government

Predictive Analytics are **a key piece of the modernization strategy**
DPAT is working closely with partners: SPO, PID and OMC

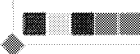**CIC is at the very beginning** of using predictive analytics
We are catching up on other countries (USA and Australia for example) and other departments (

Expectations need to be set carefully
Predictive analytics can be transformative for an organization,
but it takes a long time to put everything in place

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Predictive Analytics – Overview

What is predictive analytics and why is it important?

Predictive analytics at CIC

Steps for predictive analytics modeling

Future triaging   hrough predictive analytics

                              and triaging

DPAT – Next steps

Data and Predictive Analytics Road Map

Annexes 1: Learning from other departments

Annexes 2: Learning from foreign governments

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Explains definition and how it works. Also talk about concrete benefits in any business doing predictive analytics (Walmart, for example, or Google, that both use that now in their business to save money, profile their consumers and improve resource allocations)

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:

• Increasing processing capacity

• Facilitate program integrity exercises
• Deliver optimal client service

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OUTCOMES: auto grouping and faster processing.

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Team is new.

<u>When did we (CIC) get into predictive Analytics:</u>
TR MC and Express Entry, this year (2014) were the first projects that got approval to do predictive Analytics.
TRMC: 500K app in FTE for
Express Entry : 450K in O&M and 3 FTEs
ETA : 2 FTEs

Insist on Predictive Analytics capacity building will not happen overnight. <u>Predictive Analytics take time to implement.</u>
OTHER COUNTRIES and Other Departments have done this for a few years now: **proven value to achieve better allocation of resources.**
<u>Building partnerships is key;</u>

Passport is certainly a key one we need to work with.
And We say CIC here but a few words on passport:
-Passport has been doing long term forecasting for years in order to forecast volume of work by office; and that is related to the funding model of passport, i-e revolving funds.

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-Partners and clients:

        -OPS partners, such as OPMB-PMU, OMC-PRPD, OMC-PID, IR, CPR, and SPO.

-Historical data:

FSW: **Total number of valid records consist of 155,665** applications
Total number of **fields** is **122** unique fields
Dates covered (final decision dates) are from **2007-01-01** to **2008-02-27**

PN:**Total number of valid records consist of 111,060** applications
Total number of **fields** is **122** unique fields
Dates covered (final decision dates) are from **2007-01-02** to **2014-08-18**

CEC: **Total number of valid records consist of 25,058** applications (GCMS only)
Total number of **fields** is **122** unique fields
Dates covered (final decision dates) are from 2011-07-16 to 2014-08-15

Concrete benefits in any business doing predictive analytics: For example, Walmart and Googles, both use predictive analytics in their business to save money, profile their consumers and improve resource allocations.

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:

*Increasing processing capacity

*Facilitate program integrity exercises
*Deliver optimal client service

Data Analytics: out reach

Data Analytics Working Groups
predictive analytics demands tight collaboration with partners and the business
We started the WG in collaboration with PID. We co-chair.

Data Analytics Coalition
Great forum for sharing ideas and best practices as predictive analytics is relatively new to the federal government
Similar goals – workload distribution
Common challenges – change management, setting users expectations, poor data quality

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Predicting Final Decisions and Triaging

Predictive Analytics have two important goals:

1.

2.

For example the distribution of volumes for IEC (TR)
(163,109 IEC applications) is:

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Challenges
Finding resources to staff the team
Several projects running parallel, so there are limited opportunities to learn from the first projects and apply the lessons to other projects

Data Analytics: reach out

Data Analytics Working Groups
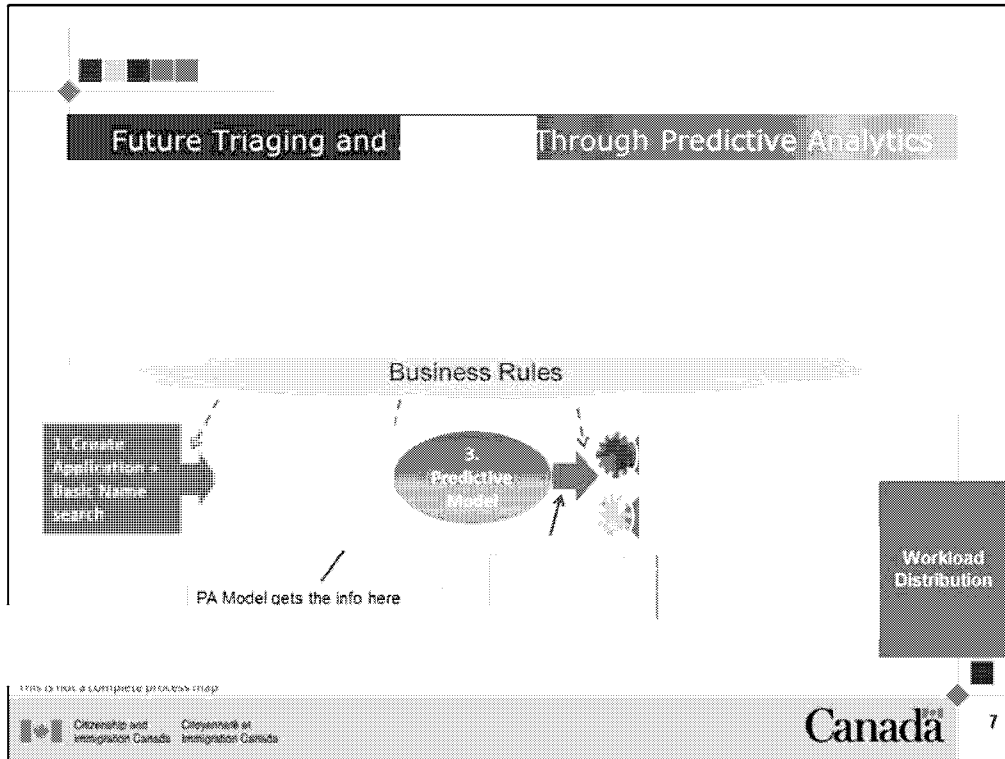predictive analytics demands tight collaboration with partners and the business
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Conclusion
Early days for predictive analytics at CIC
We are catching up quickly
Partners, such as PID and SPO, and business clients have been enthusiastic
Important to set expectations correctly

Questions?

Annex slides – "Keys Steps for Success" and "Potential Pitfalls"

Data and Predictive Analytics Road Map

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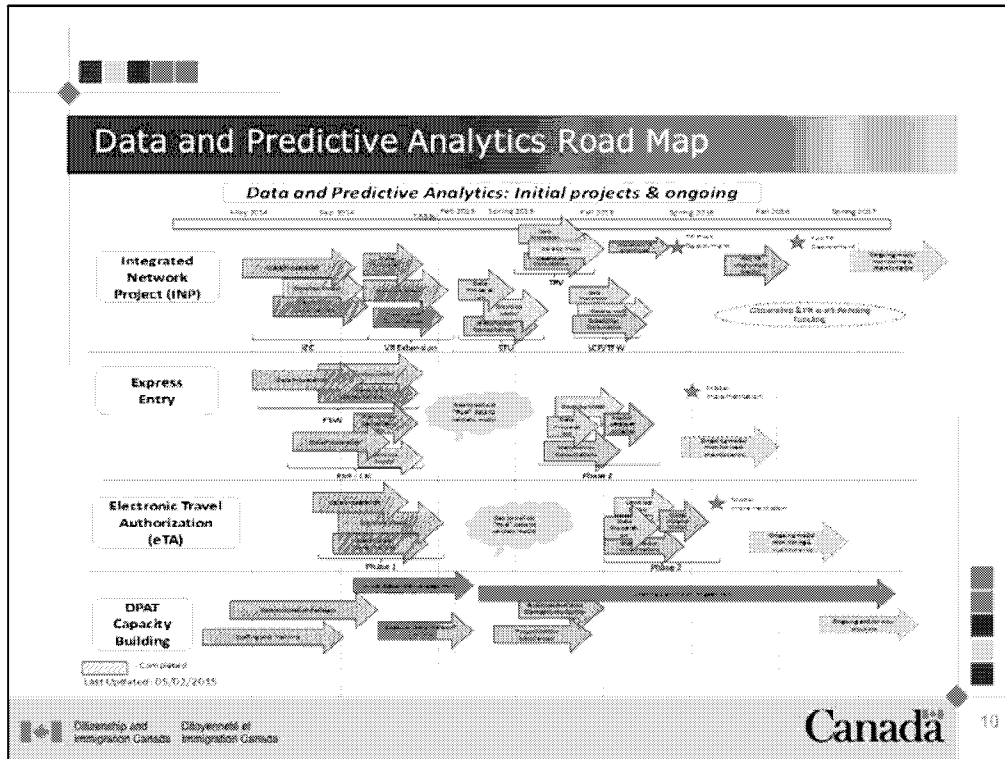
For all departments, the end goal is better allocation of resources.

Passport
Developed models to forecast demand. Data driven insights are used for business planning and budgeting

OPC - Office of the Privacy Commissioner:
Published a paper in August 2012
http://www.priv.gc.ca/information/research-recherche/2012/pa_201208_e.asp
Acknowledges the accelerating use of predictive analytics:
Targeted advertising, social science, law enforcement, location tracking, fraud prevention
Ethical guidelines are needed, with boundaries around what can be inferred from algorithms and what data can be collected for this purpose.

Analytics Coalition
Chaired by the DPAT
Share analytics best practices with OGDs who are working on analytics projects
Most have a similar goal: improve workload distribution.
The 4th meeting was on May 28, 2014

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Predictive analytics have **proven value** in private industry and government

Predictive Analytics are **a key piece of the modernization strategy**
DPAT is working closely with partners: SPO, PID and OMC

CIC is at the very beginning of using predictive analytics
We are catching up on other countries (USA and Australia for example) and other departments

Expectations need to be set carefully
Predictive analytics can be transformative for an organization,
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Predictive Analytics – Overview

eTA- Data Collection

eTA- Proxy Data Used for modelling

Process Map

Next Steps

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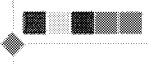
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ETA- Data Collection

- **eTA-Phase 1 of Predictive Analytics = There is no real eTA data now.** We are using the **proxy data** to build models to help identify some business rules that might be useful for the processing and triaging of the very first eTA applications.

- **In between of Phase 1 and Phase 2 = Voluntarily eTA data collection.** Since the first few months will be voluntary:
    - We think we will not have a data set that will be fully representative of the "real" ETA population;
    - The volume as well might not be enough to build any predictive analytics rules yet.

- **eTA-Phase 2 of Predictive Analytics = Period of real eTA data collection.** After some time of eTA data collection and processing of TBD% of the applications, we are going to have enough data (both in volume and in representativeness) to start building a real predictive model to deployed in production.

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eTA- Proxy Data Used for modelling

- We are using the proxy data to build models to help identify some business rules that might be useful for the processing and triaging of the very first eTA applications.
- The eTA Working Group decided, we will use the data set (s) that have similar population and data characteristics to eTA.
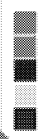
TRV (select countries)

- **Total number of valid records consist of 559,164** applications
- Total number of **fields** is about **150** unique fields
- **Dates covered** (final decision dates) are from **2013-01-01** to **2014-11-30**

STU (visa-exempt countries)

- **Total number of valid records consist of 122,921** applications
- Total number of **fields** is about **150** unique fields
- **Dates covered** (final decision dates) are from **2011-01-01** to **2014-11-06**

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eTA- Business Rules

- **Phase 1 of ETA modeling:** While we don't have the real eTA data, by using the proxy data we developed business rules that can be applied later to triaging the first eTA applications. DPAT:
    1. Found the best model for the proxy data (TRV data)
    2. Scored the applications using this model
    3. Identified **business rules** and discussed with the WG how we can use these rules to refine or fine-tune the current proposed business rules to be used at launch of eTA

-

- **Phase 2 of ETA modeling:** After the launch of ETA we will have to wait a few months (6 to 9 depending on if ETA starts with a voluntary period, as this will reduce the number of cases and will have an impact on the population most likely), we will review the models built on proxy data, including what was not used (citizenship and etc) and we will build real models to be tested and then used in production.

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Next Steps

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- Decide on the best business rules to be used for first voluntary eTA data.

- Project **eTA phase-2** will be starting in Oct 2015 (or even later, given the CR recently submitted to postpone ETA), a few months after the implementation of the eTA (6 to 9 months depending on if ETA starts with a voluntary period) in order to collect real data set that will be fully representative of the "real" eTA population.

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Citizenship and Immigration Canada

Predictive Modeling for Express Entry

OPMB-PMU-DPAT

February 2015

Canada

Predictive Analytics – Overview

EE- Data Exploration

EE- Predictive Analytics Modeling

EE- Predictive Indicators and Model

EE-Data Exploration

Triaging Rules for Express Entry

Example- CEC Predictive Dashboard

Accuracy of SPSS Triage Rules Outcome vs. GCMS

Express Entry Future Triaging Through Predictive Analytics

Next Steps

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Express Entry- Data Exploration

• Original data set had 547,215 applications with 122 unique fields

➤ Federal Skilled Worker Program (FSW)- - **72.13%**
➤ Provincial/Territorial Nominees (P/N) - **21.16%**
➤ Canadian Experience Class (CEC) - **6.69%**
➤ Skilled Trades (ST) - **0.03%**

Distribution by Programs

Skilled Workers	72.13	394689
Provincial/Territorial Nominees	21.16	115772
Canadian Experience Class	6.69	36590
Skilled Trades	0.03	164

• Missing values and outliers were removed from the data for each LOB
• As a result, each LOB has reduced number of records
• Time periods for modeling were also chosen for each LOB depending on availability and quality of the data

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For FSW, DPAT analyzed data for FSW before and after MI. As a result, before MI data was chosen for FSW. This decision was based on business knowledge and opinion on which cases should be included in the sample in the way that there would not be any lost in representativeness of our future population of applications, while preserving the quality of the data set. The fact that Express Entry does not have MI restrictions is also consistent with this choice of pre-MI time period for modeling.

For PN, data was analyzed for GCMS and CAIPS separately due to some missing values problem.   since both sets of data yield the same acceptance rate and adding more applications to build the model results in a higher degree of freedom leading to increased robustness. Thus helping to ensure that the model performs as expected (i.e. is not over-fitted).

For CEC, WG suggested that DPAT use only GCMS data from 2011 to 2014-07-04 (final decision date) given all the missing values in CAIPS.

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Concrete benefits in any business doing predictive analytics (Walmart, for example, or Googles, that both use that now in their business to save money, profile their consumers and improve resource allocations)

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:

• Increasing processing capacity

• Facilitate program integrity exercises
• Deliver optimal client service

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It is important to focus our modeling on the fields/indicators that matter the most and consider dropping those that matter least. Predictor importance does not relate to model accuracy.

The predictive power (non-weighted) of each recommended predictor is computed by Auto Data Preparation (ADP) from either a linear regression or naïve Bayes model, depending upon whether the target is continuous or categorical. In our case, the target FinDec is categorical so that Bayes naive model was used by ADP.

The Bayes model is termed *naïve* because it treats all proposed prediction variables as being independent of one another. This is why we used naive Bayes model only for initial selection of predictors.

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Triaging Rules for Express Entry

- Business rules were developed by the model for possible auto-triaging and auto-assignment.

- *

- These rules can be transferred to GCMS as XML code or series of case statements
  an officer.
- GCMS "Answers" has being explored to triage applicants in predictive dashboard for CEC.

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*
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*
* Facilitate program integrity exercises
* Deliver optimal client service
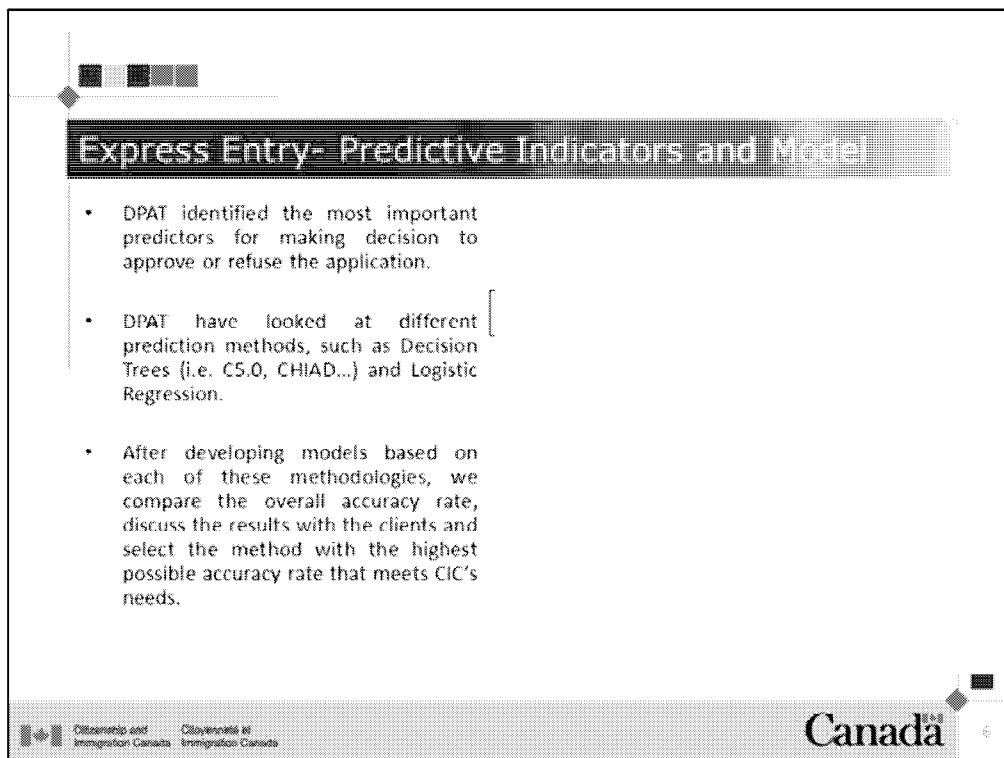

Data Analytics: out reach

Data Analytics Working Groups
predictive analytics demands tight collaboration with partners and the business
We started the WG in collaboration with PID. We co-chair.

Data Analytics Coalition
Great forum for sharing ideas and best practices as predictive analytics is relatively new to the federal government
Similar goals – workload distribution
Common challenges – change management, setting users expectations, poor data quality

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Express Entry- Data Exploration

• Original data set had 547,215 applications with 122 unique fields

➢ Federal Skilled Worker Program (FSW) - **72.13%**
➢ Provincial/Territorial Nominees (P/N) - **21.16%**
➢ Canadian Experience Class (CEC) - **6.69%**
➢ Skilled Trades (ST) - **0.03%**

Distribution by Programs

Skilled Workers	72.13	394689
Provincial/Territorial Nominees	21.16	115772
Canadian Experience Class	6.69	36590
Skilled Trades	0.03	164

• Missing values and outliers were removed from the data for each LOB
• As a result, each LOB has reduced number of records
• Time periods for modeling were also chosen for each LOB depending on availability and quality of the data

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s.16(2)

For FSW, DPAT analyzed data for FSW before and after MI. As a result, before MI data was chosen for FSW. This decision was based on business knowledge and opinion on which cases should be included in the sample in the way that there would not be any lost in representativeness of our future population of applications, while preserving the quality of the data set. The fact that Express Entry does not have MI restrictions is also consistent with this choice of pre-MI time period for modeling.

For PN, data was analyzed for GCMS and CAIPS separately due to some missing values problem. ̀   since both sets of data yield the same acceptance rate and adding more applications to build the model results in a higher degree of freedom leading to increased robustness. Thus helping to ensure that the model performs as expected (i.e. is not over-fitted).

For CEC, WG suggested that DPAT use only GCMS data from 2011 to 2014-07-04 (final decision date) given all the missing values in CAIPS.

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s.16(2)

It is important to focus our modeling on the fields/indicators that matter the most and consider dropping those that matter least. Predictor importance does not relate to model accuracy.

The predictive power (non-weighted) of each recommended predictor is computed by Auto Data Preparation (ADP) from either a linear regression or naïve Bayes model, depending upon whether the target is continuous or categorical. In our case, the target FinDec is categorical so that Bayes naive model was used by ADP.

The Bayes model is termed *naïve* because it treats all proposed prediction variables as being independent of one another. This is why we used naive Bayes model only for initial selection of predictors.

The *probability bins* like _exam marks_. Red and Green bins are _passing mark_s for applications to be processed in Canada. There will be certain number of applications that pass this mark.

Note:

For FWS, PN, CEC was used C5.0. algorithm to develop the models. Each of these LOB has different output for probability bins.

For FSW, 85% bins design.

For PN, 85% bins design.

For CEC, 85% bins design.

It is expected that business and our partners will tell us us what the future plans are for the split in processing for CEC, CPR vs. IR.

•For Phase I, this is about November, 2014

•For Phase II, this is about 6-9 months after launching Express Entry in January, 2015 when Express Entry data will be available

•Then it will be ongoing maintenance (monitoring, revision if needed) of the model

Details:

•It is anticipated to restart WG after receiving Express Entry data.

•The current triage rules and risk profiles are based on the subjective input of visa officers.
•The future plan is to make these rules exhaustive and evidence-based.

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Citizenship and Immigration Canada

Predictive Modeling for Express Entry

OPMB-PMU-DAPT
Presentation to IR & OPS
December 11, 2014

Canada

Predictive Analytics – Overview

▸ What is predictive analytics and why is it important?

▸ Predictive analytics at CIC

▸ Express Entry Predictive Analytics Modeling

▸ Express Entry – Data Exploration

▸ Model Design

▸ The Future (phase 2): Automated Triaging

▸ What Can We Use Now?

▸ Next Steps

▸ Annex 1-2: Predicting Final Decision and Triaging

▸ Annexes 3-4: Learning from other departments and foreign governments

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What is Predictive Analytics and why is this important?

▶ Predictive analytics is the process of discovering patterns in historical data and behaviours to infer the likelihood of future events and to predict probable outcomes

▶ **Predictive analytics offers the opportunity to use data to drive decisions**

Drawing on a combination of...

▷ Computer Sciences

▷ Statistics

▷ Operational expertise

▷ Specialized Software

Benefits

▷ Formally substantiates business decisions made by intuition or gut feeling

▷ Combine operational business knowledge and expertise with statistical analysis

▷ Helps reduce waste by maximizing the use of resources

▷ Enables the automation of business processes

▷ Drives smarter decision making by extracting actionable insights from the vast quantity of data available in government agencies.

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Predictive Analytics at CIC

▶ **Predictive analytics leverage statistical analysis and predictive modeling**

    ▶ Support key initiatives such as   ntegrated workload management, eTA, Express Entry and more...

    ▶ Enable and support the modernization agenda

    ▶ Contributes to CIC's toolkit for detecting fraud

What happened?	Why did it happen?	What will happen?	Output	Future Outcomes
▸ Standard reports	▸ Data analysis	▸ Predictive modeling	▸ Business rules to manage workload and achieve modernization goals	▸ Real-time and responsive predictive analytics
▸ Ad-hoc reports	▸ Data is captured, but not fully leveraged for business purposes	Scenario building		
▸ A combination of manual processes and modernization initiatives		▸ Risk criteria identified, managed and validated		
				▸ Create opportunities for better client service and faster processing

Sense and Act   **Predict and Respond**

Canada

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Predictive Analytics at CIC (cont'd)

▶ **The Data and Predictive Analytics Team**

   ▶ **A new team in OPMB/ PMU**

   ▶ Established and funded by MCs to deliver specific projects with ongoing funds for maintenance activities

   ▶ Leveraging established relationships with Business Intelligence (BI) resources in OPMB.

   ▶ Working closely with internal partners such as OMC/ Program Integrity Division (PID) and the Strategic Project Office (SPO).

   ▶ Building partnerships with other departments and foreign governments.

   ▶ **Passport:**

      ▶ Passport has been doing forecasting and analytics for workload management for years.

▶ **Predictive analytics requires a long term commitment**

   ▶ Develop the requisite technical skills

   ▶ Acquire the necessary business knowledge

   ▶ Build, validate and deploy the predictive models

Analysis

Predictive Analytics

Expertise   Data

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Express Entry Predictive Analytics Modeling

Collect Data and Business Requirements

Conduct preliminary Data Analysis

Develop Predictive Models

Validate Predicative Models

Conduct Statistical modeling of risk/complexity scoring

Implement Predictive Models

Monitor and Maintain Models

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s.16(1)(b)

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Express Entry- Data Exploration

FSW

- **Total number of valid records consist of 155,665** applications
- Total number of **fields** is **122** unique fields
- **Dates covered** (final decision dates) are from **2007-01-01** to **2008-02-27**

PN

- **Total number of valid records consist of 111,060** applications
- Total number of **fields** is **122** unique fields
- **Dates covered** (final decision dates) are from **2007-01-02** to **2014-08-18**

CEC

- **Total number of valid records consist of 25,058** applications (GCMS only)
- Total number of **fields** is **122** unique fields
- **Dates covered** (final decision dates) are from **2011-07-16** to **2014-08-15**

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Model Design

Phase 1 vs. Phase 2:

- Program Risk Indicators were tested and some adjustments were made to improve their effectiveness for Phase 1.

- When Express Entry data becomes available, DPAT and partners will improve upon the Phase 1 Program Risk Indicators/triage criteria, implementing more complex evidence based indicators, such as those on this slide.

- This should improve the accuracy and precision of triaging.

The Future (phase 2): Automated Triaging

- Each Express Entry application coming trough GCMS will be assessed and **scored against predictive model and indicators,** as per the model that was developed with Express Entry data (draft model will be validated with 6 to 9 months of "real" Express Entry data).

- **Once the case is scored**, the system will auto-assign the case to a decision-maker (or to a group of decision-makers).

- The predictive model will break down the Express Entry case-load into **3 Bins:**

    Level one decision makers

    Level two decision makers

    Level three decision makers

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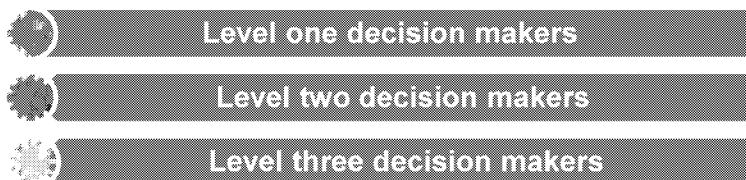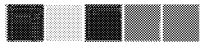
What Can We Use Now?

- The plan is to use the work done on Predictive modeling so far for Phase 2, to feed into Phase 1 manual triaging and workload distribution.

- The draft bins developed could be used as a "guide" for manual triaging of the cases. Once we have post-launch data, we can re-validate and change if need be.

- Some of the scenarios include the following:

	FSW	PN	CEC
Level one decision makers	40.8%	67.2%	82.9%
Level two decision makers	32.6%	25.4%	2.0%
Level three decision makers	26.6%	7.5%	15.1%

Note: See Annex 2 for details

Next Steps

Implementation of manual triage instructions upon launch of Express Entry

Ongoing monitoring of Program risk and triage indicators following Express Entry

Continued Express Entry Predictive Model validation until Fall 2015

Fraud Trend Analysis Exercise in Fall 2015 once enough Express Entry Data has been received

Models will be validated to evolve triaging rules for design of Express Entry using Express Entry data

Predictive Analytics on Express Entry will include the future vision of Integrated Network Project

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Annex 3: Learning from Other Departments

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Data and Predictive Analytics Team

(DPAT), PMU/OPMB

Electronic Travel Authorization (eTA) Modelling:

Data Exploration

Prepared by the Data and Predictive Analytics Team (DPAT) in PMU (OPMB)
10/8/2014

s.16(1)(b)

s.16(2)

1. Current situation with the data

As it was decided by eTA Working Group, for eTA modelling work DPAT will use the data set (s) that have a similar population and/or the closest data characteristics.

    a. TFW and STU from visa-exempt countries (excluding US and Canada)

    b. TRVs from visa required countries (selected countries only, see Annex 5.4)

Currently, only **subset of the TFW and STU** data is available for DPAT for analysis:

- Only 2011 and 2012 GCMS data,

Revised Proposal - Predictive Analytics Deployment Strategy for ETA November 2015

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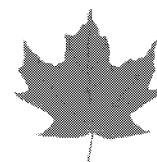
Original Business Proposal

(Deployment of Predictive Analytics in the eTA program)

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s.16(2)

1. A **Real-time Process** transfers new application data from GCMS to Predictive models

2. Application/client related information   s stored in a Data Repository.

    2a: A Batch Process transfers incremental data from GCMS to EDW-IDM every 24 hours, to integrate with

    2b: Information is fetched from other data sources

3. The predictive model obtains identified indicators associated to the new application from the Data Repository.

4. The predictive model generates three fields for each new application:

5. **This information is written back to GCMS real time for either silent mode testing or production**

6.

2

s.16(1)(b)

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Original Business Proposal – Conceptual View
(Deployment of Predictive Analytics in the eTA program)

	GCMS	
Application #	GCMS Decision	

6

Real-time   1

GCMS

Real-time write back
5   Silent mode/production

Other Source   Other Source

2a   Load: 24 hrs

2b

2

Other data for Predictive Analytics

2c

4

3

Predictive Model Production Deployment (SPSS Server)

Note: See next slide for details

s.16(1)(b)

s.16(2)

New Option

(Less intrusive workaround to solidify and enable use of Predictive Analytics in the eTA program in November 2015)

1. A **Batch Process** transfers incremental data from GCMS to EDW every 24 hours to integrate with

2. Application/client related information   is stored in a Data Repository.

    2a: Information related to the new data is fetched from other data sources

3. The predictive model obtains identified indicators associated to the new application from the Data Repository

4. The predictive model generates three fields for each new application:

   This information is written to EDW.

5.

6.

4

s.16(1)(b)

s.16(2)

New Option – Conceptual View
(Less intrusive workaround to solidify and enable use of Predictive Analytics in the eTA program in November 2015)

GCMS

Other Source

Other Source

2a

Load: 24 hrs delay

2

Other data for Predictive Analytics

2b

3

Predictive Model Deployment Prototype
(SPSS Server)

4

5

6

Predictive Model
Performance Monitoring

	GCMS
Application #	GCMS Decision

Note: See next slide for details

5

Risk of not deploying a real-time predictive model in November 2015 – Low

- Background
    - We don't have a solid predictive model for eTA phase 1,

    –

    –

    –

- Would not deploying in real-time impact the accuracy of predictive analytics?
    - No.

- Would it be sufficient to adopt this option without GCMS change?
    - No. The current eTA processing time is 3 minutes. This option would add at least 1 day to processing time, and additional processing effort from officers.
- What will we get out of this option?
    - Prior to significant investment in changing GCMS, we can simulate model deployment and model performance monitoring.
    –
- What do we require to implement this option?
    - Funding for acquiring SPSS Server and associated infrastructure
    - Resources to bring in additional data from other sources

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Data requirements

Data required for Development Phase for Predictive Models

- So far, the following data has been provided by DMT for development of predictive model:
    -
    -
    -
    -
    - Note: For more information, refer to detailed DPAT business requirements.

Data Required to Improve Predictive Models

-

- Other information – longer term
    - Our Predictive Analytics team has not yet explored these areas, and our current 12 models used mainly CIC information so far
    - Examples of other information:

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Predictive Analytics Modelling Current Plan

	Program	Predictive Models Developed	Predictive Model under Development	Testing Date	Tentative Go live Date *
1	eTA		eTA	November 2015	April 2016
2	eTA expansion		eTA expansion	TBD	TBD
3	TR Pilot	Student		February 2016	June 2016
4		VR Extension		February 2016	June 2016
5			IEC	February 2016	June 2016
6	Full TR	Student		March 2016	January 2017
7		VR-Extension		March 2016	January 2017
8			TRV	March 2016	January 2017
9			TFW	March 2016	January 2017
10			LCP	March 2016	January 2017
11			IEC	March 2016	January 2017
12	PR	Express Entry -CEC		March 2016	June 2016
13		Express Entry -FSW		March 2016	June 2016
14		Express Entry -PN		March 2016	June 2016

* Go live data under revision

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Meeting with John Acheson on Express Entry Predictive Analytics Models

Background

In January 2015, predictive analytics (PA) models were developed and presented for FSW, CEC and PN using historical data for these programs. Please see Master Document for the reference. These PA models were revised for FSW and CEC with addition of new historical and derogatory information for Express Entry actual data for 2015/03 to 2016/02 time period. For PN, there were not enough applications received to build PA model. It is anticipated that PN model will be developed once data available.

Additional Datasets

DPAT has been provided with two new distinct data sources containing historical and derogatory information.

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PA Models

C5 algorithm

PA models were built using **C5 algorithm** to generate predictive information as input to decision making. C5 builds a decision tree that works by splitting the sample based on the field that provides the maximum information gain. Each subsample defined by the first split is then split again, usually based on a different field, and the process repeats until the subsamples cannot be split any further. Finally, the lowest-level splits are reexamined, and those that do not contribute significantly to the value of the model are removed or pruned.

Validation of PA Models

Models are validated by **partitioning** the data into separate subsets or samples for the training, testing, and validation stages of model building. One sample is used for generating the model and others for testing and validation of results.

DPAT developed an algorithm to automatically create a large number of models and chose the one with the highest accuracy.

Probability Bins

Bins accuracy is the number of cases identified by the model correctly (each bin has certain number of misidentified cases) given the threshold established by business experts.

DATA AS OF NOVEMBER 15, 2017

OVERVIEW:

- NHQ sent 1,085 applications for the pilot in the spring of 2017; 1,046 (96.4%) files already had an eligibility decision by November 15, 2017.

  - Only 811 of these files were coded with the pilot "org" (results shown below on this page).

  - 274 were not coded with the pilot org; we do not know why.

  - Combined results for all applications in the pilot (whether they have the org or not) are shown on the next page. The combined results are slightly better than those in or org.

FOR APPLICATIONS ASSIGNED TO THE "ORG" OF THE PILOT

Manila

- Of the 295 applications sent to Manila under the pilot and which had the "org", 279 (94.6%) had an eligibility decision by November 15. 2017.
  -
  -

New Delhi

- Of the 516 applications sent to New Delhi under the pilot and which had the "org", 509 (98.6%) had an eligibility decision by November 15 2017.
  -
  -

Both offices combined

- Overall, 788 out of 811 applications (97.2%) had an eligibility decision by November 15, 2017.
  -
  -

FOR ALL APPLICATIONS IN THE PILOT (WHETHER THEY HAD THE "ORG" OR NOT)

Manila

- Of the 399 applications sent to Manila under the pilot, 380 (95.2%) had an eligibility decision by November 15, 2017.

New Delhi

- Of the 686 applications sent to New Delhi under the pilot, 666 (97.1%) had an eligibility decision by November 15, 2017.

Both offices combined

- Overall, 1,046 out of 1,085 applications (96.4%) had an eligibility decision by November 15, 2017.

UPDATE: FC1 and FCC Pilot in Manila and New Delhi

Data as of October 18, 2017

OVERVIEW:

- NHQ sent 1,085 applications for the pilot in the spring of 2017; 1,030 (94.8%) files already had an eligibility decision by October 18, 2017.

  - Only 808 of these files were coded with the pilot "org" (results shown below on this page).

  - 278 were <u>not</u> coded with the pilot org; we do not know why.

  - Combined results for all applications in the pilot (whether they have the org or not) are shown on the next page. The combined results are slightly better than those in or org.

FOR APPLICATIONS ASSIGNED TO THE "ORG" OF THE PILOT

<u>Manila</u>

- Of the 293 applications sent to Manila under the pilot and which had the "org", 277 (94.5%) had an eligibility decision by October 18, 2017.
  - ○
  - ○

<u>New Delhi</u>

- Of the 515 applications sent to New Delhi under the pilot and which had the "org", 501 (97.3%) had an eligibility decision by October 6, 2017.
  - ○
  - ○

<u>Both offices combined</u>

- Overall, 779 out of 808 applications (96.4%) had an eligibility decision by October 18, 2017.
  - ○
  - ○

FOR ALL APPLICATIONS IN THE PILOT (WHETHER THEY HAD THE "ORG" OR NOT)

Manila

- Of the 397 applications sent to Manila under the pilot, 378 (95.2%) had an eligibility decision by October 18, 2017.

New Delhi

- Of the 685 applications sent to New Delhi under the pilot, 651 (95.8%) had an eligibility decision by October 18, 2017.

Note: 4 of the 1,086 applications in the pilot can no longer be found in the Enterprise Data Warehouse.

Both offices combined

- Overall, 1,030 out of 1,086 applications (94.8%) had an eligibility decision by October 18, 2017.

UPDATE: FC1 and FCC Pilot in Manila and New Delhi

Data as of September 22, 2017

OVERVIEW:

- NHQ sent 1,086 applications for the pilot in the spring of 2017; 1,015 (93.5%) files already had an eligibility decision by September 22, 2017.
  - Only 808 of these files were coded with the pilot "org" (results shown below on this page).
  - 278 were <u>not</u> coded with the pilot org; we do not know why.
  - Combined results for all applications in the pilot (whether they have the org or not) are shown on the next page. The combined results are slightly better than those in or org.

FOR APPLICATIONS ASSIGNED TO THE "ORG" OF THE PILOT

Manila

- Of the 293 applications sent to Manila under the pilot and which had the "org", 276 (94.2%) had an eligibility decision by September 22, 2017.
  - ○
  - ○

New Delhi

- Of the 515 applications sent to New Delhi under the pilot and which had the "org", 499 (96.9%) had an eligibility decision by September 22, 2017.
  - ○
  - ○

Both offices combined

- Overall, 775 out of 808 applications (95.9%) had an eligibility decision by September 22, 2017.
  - ○
  - ○

FOR ALL APPLICATIONS IN THE PILOT (WHETHER THEY HAD THE "ORG" OR NOT)

Manila

- Of the 397 applications sent to Manila under the pilot, 377 (94.9%) had an eligibility decision by September 22, 2017.
    - ○
    - ○

New Delhi

- Of the 685 applications sent to New Delhi under the pilot, 638 (93.1%) had an eligibility decision by September 22. 2017.
    - ○
    - ○

Note: 4 of the 1,086 applications in the pilot can no longer be found in the Enterprise Data Warehouse.

Both offices combined

- Overall, 1,015 out of 1,086 applications (93.5%) had an eligibility decision by September 22, 2017.
    - ○
    - ○

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FC1/FCC Pilot Project for New Delhi and Manila

Contents

> Summary of the numbers regarding the current status of the pilot project in Manila and New Delhi on the FC1- Spousal /FCC - Common Law sponsorship triage criteria used by the Predictive Analytics Team (PAT).

QAs:

- What is the overall approval rate at eligibility for all applications during the **same time period** as the pilot applications were decided, based on eligibility decision date?

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Pilot- June Data

The results so far shows that 725 out of 738 cases already processed passed the eligibility requirements. In other words, mission results concurred with the triage criteria presented by PAT in 98.24% of the cases.

As a result of the last run (June data), 738 cases were processed out of the 1086 cases, representing 67.95% of the total cases sent. 339 of those cases were sent to Manila and 687 to New Delhi.

1. For both New Delhi and Manila:

Distribution of Eligibility Decision for Both Missions

Value	Proportion	%	Count
Failed		1.76	13
Passed		98.24	725

Distribution of Interviews for Both Missions

2. For New Delhi:

There were 474 cases processed out 687 cases sent to the New Delhi primary office (69%).

Distribution of Eligibility Decision for New Delhi

3

Distribution of Interviews for New Delhi

3. For Manila:

There were 264 cases processed at Manila primary office out of 399 cases sent to Manila (66%).

Distribution of Eligibility Decision for Manila

Distribution of Interviews for Manila

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Pilot — May Data

1. For both New Delhi and Manila:

Distribution of Eligibility Decision for Both Missions

There were 573 cases processed by both Missions (Manila and New Delhi) out of 1086 cases sent by PAT.
Out of these 584 cases, 573 passed the validation rules (98.12%).

Value	Proportion	%	Count
Passed		98.12	573
Failed		1.88	11

Distribution of Interviews for Both Missions

2. For New Delhi:

There were 404 cases("not started ") processed by the mission at Manila primary office out of 687 cases ("not started ") sent by PAT. thus, until our last June run, 58.80% of the cases sent to New Delhi were processed.

Distribution of Eligibility Decision for New Delhi

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3. For Manila:

There were 180 cases ("in progress") processed at Manila primary office out of 295 cases ("in progress") sent by PAT. It seems that 104 cases ("not started ") sent by PAT were not processed by Manila office yet. In total there were 399 cases sent to Manila.

Distribution of Eligibility Decision for Manila

Some notes on number of cases needed for testing or revision of the model for Express Entry once actual data is available

For Express Entry, DPAT should be able to conduct the first testing and if necessary revision of the model by the end of June 2015 given ITA estimate of 18,300-20,300 for by the end of June 2015 and Admissions estimate of 7,100-7,900 for 2015.

It was assumed that there would be approximately 4,000 admissions by the end of June (half of projected 7,900 admissions for 2015). Historical data from 2007-01-01 to 2014-08-15 (final decision date) showed that FSW were accountable for ~72% of the total for 4 programs such as FS, PN, CEC and ST. The 72% of 4,000 projected admissions implies 2,880 cases by the end of June, 2015. This is approximately 2% of the data set used in Express Entry model. The model was tested for randomly taken sample of 2% (2,936) of the data set and the results were proven to be reasonable and valid.

There were five trials conducted to see if the model still results in accurate prediction for five randomly selected 2% samples of data set.

The table showed that for 2,990 cases, SPSS predicted correctly 2,650 cases (88.63%) and 340 cases were predicted with less accuracy (11.37%). That is the acuracy of the model is 89%.

The accuracy of the model varied insignificant from 86% to 89% for five randomly selected data samples. This indicates the robustness of the model for 2% sample of the data.

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Immigration Canada   Immigration Canada

Citizenship and Immigration Canada

Predictive Modeling for Express Entry

OPMB-PMU-DAPT
Presentation to IR & OPS
December 11, 2014
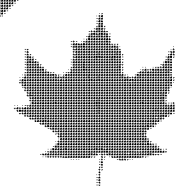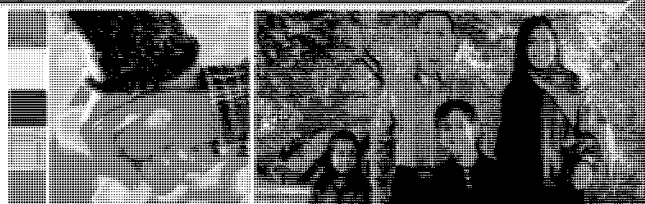
Canada

Predictive Analytics – Overview

What is predictive analytics and why is it important?

Predictive analytics at CIC

Express Entry Predictive Analytics Modeling

Express Entry – Data Exploration

The Future (phase 2): Automated Triaging

Next Steps

Annexes 1-2: Learning from other departments and foreign governments

What is Predictive Analytics and why is this important?

▶ Predictive analytics is the process of discovering patterns in historical data and behaviours to infer the likelihood of future events and to predict probable outcomes

▶ **Predictive analytics offers the opportunity to use data to drive decisions**

Drawing on a combination of...

▷ Computer Sciences

▷ Statistics

▷ Operational expertise

▷ Specialized Software

Benefits

▷ Formally substantiates business decisions made by intuition or gut feeling

▷ Combine operational business knowledge and expertise with statistical analysis

▷ Helps reduce waste by maximizing the use of resources

▷ Enables the automation of business processes

▷ Drives smarter decision making by extracting actionable insights from the vast quantity of data available in government agencies.

Canada

3

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s.16(1)(b)

s.16(2)

Predictive Analytics at CIC

▶ Predictive analytics leverage statistical analysis and predictive modeling

> ▶ Support key initiatives such as   integrated workload management, eTA, Express Entry and more...
>
> ▶ Enable and support the modernization agenda
>
> ▶ Contributes to CIC's toolkit for detecting fraud

What happened?	Why did it happen?	What will happen?	Output	Future Outcomes
▸ Standard reports	▸ Data analysis	▸ Predictive modeling ▸	Business rules to manage workload and achieve modernization goals	▸ Real-time and responsive predictive analytics
▸ Ad-hoc reports	▸ Data is captured, but not fully leveraged for business purposes	Scenario building		
▸ A combination of manual processes and modernization initiatives		▸ Risk criteria identified, managed and validated	▸	▸
			▸	
				▸ Create opportunities for better client service and faster processing

Sense and Act

Predict and Respond

A-2018-09320-000318

Predictive Analytics at CIC (cont'd)

► **The Data and Predictive Analytics Team**

  ► **A new team in OPMB/ PMU**

  ► Established and funded by MCs to deliver specific projects with ongoing funds for maintenance activities

  ► Leveraging established relationships with Business Intelligence (BI) resources in OPMB.

  ► Working closely with internal partners such as OMC/ Program Integrity Division (PID) and the Strategic Project Office (SPO).

  ► Building partnerships with other departments and foreign governments.

  ► **Passport:**

    ► Passport has been doing forecasting and analytics for workload management for years.

► **Predictive analytics requires a long term commitment**

  ► Develop the requisite technical skills

  ► Acquire the necessary business knowledge

  ► Build, validate and deploy the predictive models

Analysis

Predictive
Analytics

Expertise ━━━━━━━━━━━━━━━━━ Data

s.16(1)(b)

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Express Entry Predictive Analytics Modeling

Collect Data and Business Requirements

Conduct preliminary Data Analysis

Develop Predictive Models

Validate Predicative Models

Conduct Statistical modeling of risk/complexity scoring

Implement Predictive Models

Monitor and Maintain Models

Canada

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s.16(1)(b)

s.16(2)

Express Entry- Data Exploration

FSW
- **Total number of valid records consist of 155,665** applications
- Total number of **fields** is **122** unique fields
- **Dates covered** (final decision dates) are from **2007-01-01** to **2008-02-27**

PN
- **Total number of valid records consist of 111,060** applications
- Total number of **fields** is **122** unique fields
- **Dates covered** (final decision dates) are from **2007-01-02** to **2014-08-18**

CEC
- **Total number of valid records consist of 25,058** applications (GCMS only)
- Total number of **fields** is **122** unique fields
- **Dates covered** (final decision dates) are from **2011-07-16** to **2014-08-15**

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s.16(1)(b)
s.16(2)

The Future (phase 2): Automated Triaging

- Each Express Entry application coming through GCMS will have business rules applied then **scored against predictive model and indicators,** as per the model that was developed with Express Entry data (draft model will be validated with 6 to 9 months of "real" Express Entry data).

-

The predictive model will break down the Express Entry case-load into **3 Bins**

Of note: the bins and the colors do not necessarily mean workload distribution. The allocation can be adjusted based on CIC's decisions.

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Next Steps

Implementation of manual triage instructions upon launch of Express Entry

Ongoing monitoring of Program risk and triage indicators following Express Entry

Continued Express Entry Predictive Model validation until Fall 2015

Fraud Trend Analysis Exercise in Fall 2015 once enough Express Entry Data has been received

Models will be validated to evolve triaging rules for design of Express Entry using Express Entry data

Predictive Analytics on Express Entry will include the future vision of Integrated Network Project

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s.16(1)(b)

s.16(2)

Annex 1: Learning from Other Departments

Canadian Border Services Agency (CBSA)

Cargo Inspection

Canada

Page 325

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of the Access to Information Act

de la Loi sur l'accès à l'information

s.16(1)(b)

s.16(2)

Citizenship and Immigration Canada

Predictive Modeling for Express Entry

OPMB-PMU-DPAT

December 2014

Canadä

SK or Hubert:

Predictive analytics have **proven value** in private industry and government

Predictive Analytics are **a key piece of the modernization strategy**
DPAT is working closely with partners: SPO, PID and OMC

CIC is at the very beginning of using predictive analytics
We are catching up on other countries (USA and Australia for example) and other departments

Expectations need to be set carefully
Predictive analytics can be transformative for an organization,
but it takes a long time to put everything in place

Predictive Analytics – Overview

What is predictive analytics and why is it important?

Predictive analytics at CIC

Express Entry Predictive Analytics Modeling

Express Entry – Data Exploration

Express Entry- Predictive Indicators and Model

Predicting Final Decision and Triaging

Express Entry- Next Steps

Annexes 1-2: Learning from other departments and foreign governments

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s.16(1)(b)
s.16(2)

MJ opens and explains definition and how it works. Also talk about concrete benefits in any business doing predictive analytics (Walmart, for example, or Google, that both use that now in their business to save money, profile their consumers and improve resource allocations)

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:

* Increasing processing capacity

* Facilitate program integrity exercises
* Deliver optimal client service

How will predictive analytics help to detect fraud?:
• First, we will identify cases where we already know there is fraud
• Next, we will apply analytics to assess the cases for common characteristics
• Once we identify these characteristics, we will develop business rules to asses new cases to see if they share these characteristics – if they do, we will flag them for detailed examination

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s.16(2)

MJ:
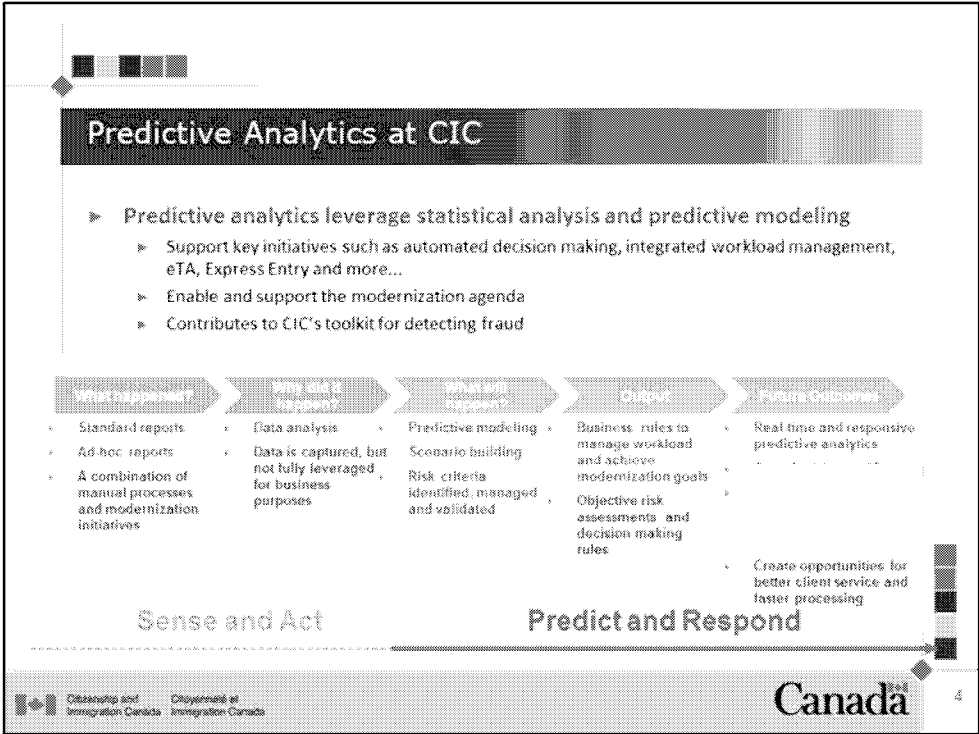
Read the deck bullets and insist on OUTCOMES: auto grouping and faster processing.

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MJ:

Team is new.
When did we (CIC) get into predictive Analytics:
 TR MC and Express Entry, this year (2014) were the first projects that got approval to do predictive Analytics.
TRMC: 500K app in FTE for
Express Entry : 450K in O&M and 3 FTEs
ETA : 2 FTEs

Insist on Predictive Analytics capacity building will not happen overnight. Predictive Analytics take time to implement.
OTHER COUNTRIES and Other Departments have done this for a few years now: **proven value to achieve better allocation of resources.**
Building partnerships is key;

Passport is certainly a key one we need to work with.
And We say CIC here but a few words on passport:
-Passport has been doing long term forecasting for years in order to forecast volume of work by office; and that is related to the funding model of passport, i-e revolving funds.
-Passport has not yet done analytics on decision making for applications.
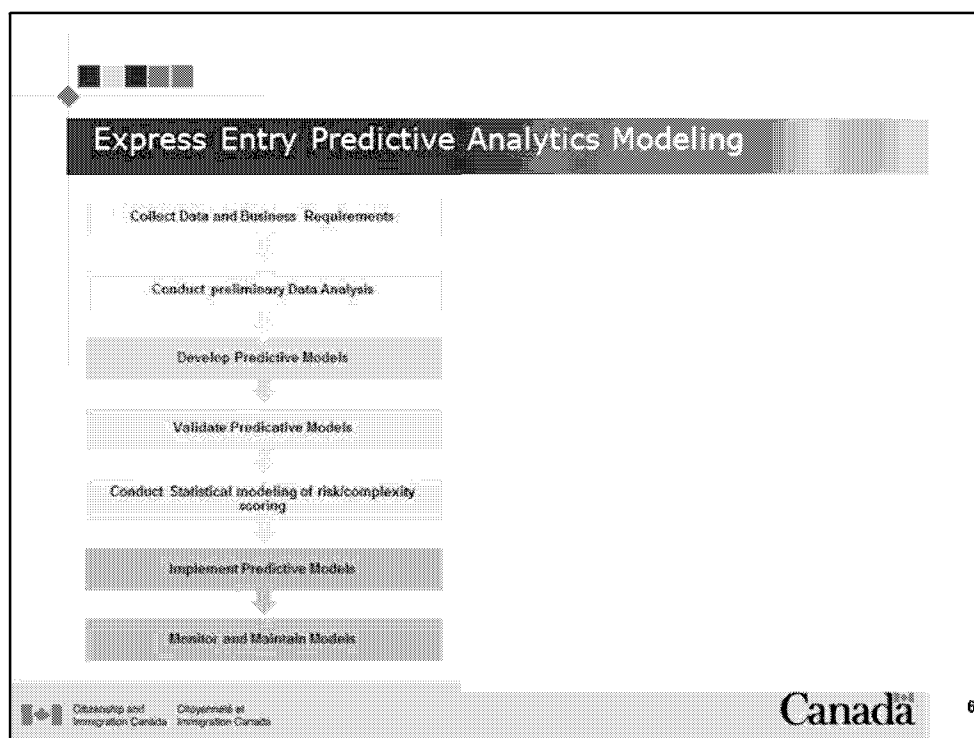
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s.16(1)(b)
s.16(2)

Concrete benefits in any business doing predictive analytics (Walmart, for example, or Googles, that both use that now in their business to save money, profile their consumers and improve resource allocations)

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:

* Increasing processing capacity
* Consistency of application decisions

* Deliver optimal client service

Data Analytics: out reach

Data Analytics Working Groups
predictive analytics demands tight collaboration with partners and the business
We started the WG in collaboration with PID. We co-chair.
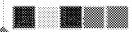
Data Analytics Coalition
Great forum for sharing ideas and best practices as predictive analytics is relatively new to the federal government
Similar goals – workload distribution
Common challenges – change management, setting users expectations, poor data quality

For FSW, DPAT analyzed data for FSW before and after MI. As a result, before MI data was chosen for FSW. This decision was based on business knowledge and opinion on which cases should be included in the sample in the way that there would not be any lost in representativeness of our future population of applications, while preserving the quality of the data set. The fact that Express Entry does not have MI restrictions is also consistent with this choice of pre-MI time period for modeling.

For PN, data was analyzed for GCMS and CAIPS separately due to some missing values problem.   since both sets of data yield the same acceptance rate and adding more applications to build the model results in a higher degree of freedom leading to increased robustness. Thus helping to ensure that the model performs as expected (i.e. is not over-fitted).

For CEC, WG suggested that DPAT use only GCMS data from 2011 to 2014-07-04 (final decision date) given all the missing values in CAIPS.

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s.16(2)

It is important to focus our modeling on the fields/indicators that matter the most and consider dropping those that matter least. Predictor importance does not relate to model accuracy.

The predictive power (non-weighted) of each recommended predictor is computed by Auto Data Preparation (ADP) from either a linear regression or naïve Bayes model, depending upon whether the target is continuous or categorical. In our case, the target FinDec is categorical so that Bayes naive model was used by ADP.

The Bayes model is termed *naïve* because it treats all proposed prediction variables as being independent of one another. This is why we used naive Bayes model only for initial selection of predictors.

The *probability bins* like *exam marks*. Red and Green bins are *passing mark*s for applications to be processed in Canada. There will be certain number of applications that pass this mark. This number of applications depends on the threshold (in our case 85% for PN and CEC and 80% for FSW) that is established in agreement with business and our partners. Yellow bins means that the probability for FinDec to be approved or failed is not that certain (between 60% and 85% in our case) so that applications from these bins will go for processing overseas for FSW and PN. For CEC, 99% applications is processed in Canada so that cases corresponding to Yellow bin will go for the additional QA.

Note: For each application that comes into GCMS, the Predictive Analytics Models will produce the probability that predicted FinDec will be approved or refused. For FWS, PN, CEC was used C5.0. algorithm to develop the models. Each of these LOB has different output for probability bins.

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Immigration, Réfugiés
et Citoyenneté Canada

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Predicting Final Decisions and Triaging (cont'd)

Results achieved to date give us the following distribution of volume for Express Entry:

Note: The accuracy of the model does not depend on the choice of the probability threshold.

Canada   10

For FSW,

For PN,

For CEC,

•For Phase I, this is about November, 2014

•For Phase II, this is about 6-9 months after launching Express Entry in January, 2015 when Express Entry data will be available

•Then it will be ongoing maintenance (monitoring, revision if needed) of the model

Details:

•It is anticipated to restart WG after receiving Express Entry data.
•It is also planned to work with GCMS to develop Answers Dashboard for possible auto-triaging and auto-assignment.
•The current triage rules and risk profiles are based on the subjective input of visa officers.
•The future plan is to make these rules exhaustive and evidence-based.

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Annex 1: Learning from Other Departments

Canadian Border Services Agency (CBSA)

Canada   12
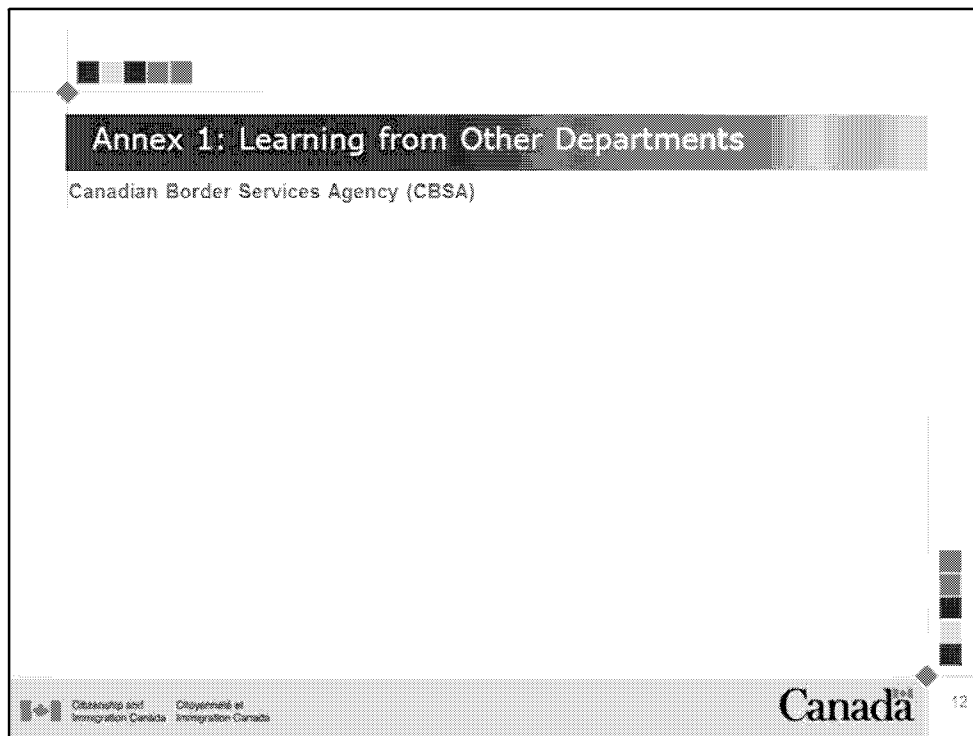
For all departments, the end goal is better allocation of resources.

Analytics Coalition
Chaired by the DPAT
Share analytics best practices with OGDs who are working on analytics projects
Most have a similar goal: improve workload distribution.
The 4th meeting was on May 28, 2014

Hubert/ SK to mention

ɪ:

Express Entry Data Analytics sub WG[1]. Held December 3rd, 2014
General Notes, action items and next steps

General notes

WG discussed prepared by DPAT master document that combined DPAT's data exploration and modeling for three LoBs FSW, PN and CEC. It was decided to change the wording for the Bins renaming green, red and yellow bins as high probability of approval, high probability of refusal and final decision probability is uncertain correspondingly.

It was mentioned that previous referral to CIC's future plans to split processing between in-Canada and Overseas, namely 60-40-split should be reconsidered.

WG didn't have time left to go over all Decision Trees in the document.

Randy suggested adding definition of the "mode".

Randy provided his suggestions for some wording in the document regarding how to address FinDec (passed FinDec vs. FinDec approved) and some other comments.

Action items

1. DPAT changed wording for bins according to WG suggestions
2.
3. Business rules were developed as parts of decision tree for CEC for WG consideration
4. Mode definition was included to the master document
5. Randy's comments and suggestions were reflected in the master document

Next steps

1. Develop a full set business rules that we can use for triaging rules
2.
3. Continue to work on modeling for Express Entry LoBs
4. Continue to work on master document
5. Determine how many applications we need to build a model based on EE data

---

[1] See invite from the meeting for attendees, but these groups were represented: OPMB-DPAT, OMC-PID, OMC-TRPD, IR, and SPO.

6.   Discuss and agree on final placement of Predictive Analytics Model in GCMS

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s.16(2)

Express Entry Data Analytics sub WG[1]. Held January 19[n], 2015
General Notes, action items and next steps

General notes

WG closed the First Phase of work on predictive analytics for Express Entry as described in corresponding final master document. It was mentioned that the work gets in the "cloud state" waiting for actual data to come for model to be tested and if necessary revised at spring/summer time period. The first two weeks data after the launch of Express Entry showed that there was a chance that the profile of new applicant would match MI1 profile. It also showed that CEC wasn't the smallest LoB to apply.

Action items

1. DPAT toned down the sentence regarding security screening as suggested by OMC and PRPD
2. DPAT sent final master document to WG
3. Send out the last EE Dashboard, and get all EE-WG members on the distribution list

Next steps

2. Determine how many applications we need to build a model based on EE data
3. Possible engagement of senior management in the discussion on final placement of Predictive Analytics Model in GCMS

---

[1] See invite from the meeting for attendees, but these groups were represented: OPMB-DPAT, OMC-PID, OMC-TRPD, IR, and SPO.

Data and
Predictive
Analytics Team
(DPAT),   PMU/ OPMB

Justification of
Education for eTA
questionnaire

Prepared by the Data and Predictive Analytics Team (DPAT)
in PMU (OPMB)
9/17/2014

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1. Purpose

The purpose of this document is to justify the importance of inclusion of EDUCATION level attainment into eTA questionnaire. In this document EDUCATION was presented in the same way as it was defined for FSW (includes different levels of education such as None, Secondary or Less, Trade Certificate, Non-University Certificate, Post-Graduate – no degree, University – no degree, Bachelor degree, Master's degree, Doctorate) and STUDENTS (STU) (includes different levels of education such as Secondary or Less, Trade, Other Post-Secondary, University, Other).

We were also asked to investigate the importance of educational institution, start date, end date, city and country of education. However[1], as the data is not always or not at all in GCMS fields (but rather in Schedule 1 info) or we do not have it at all (for students), we did not try to make up numbers or justifications. We could however say that information on education (dates from and to, and institution) could certainly add value to modeling as we have seen other similar data points offering good indicators.

1.1. The eTA application

In order to simplify the process and meet travellers' expectations, the eTA application is designed to be very simple with smart/filtered questionnaire flow. <u>It means that the number of indicators for the automated approval process might well be very limited</u>. We also have to make sure that a streamline application process does not impede CIC's ability to use the data collected from eTA clients to do Data Analytics and Predictive Analytics (or any other automation tools that we will use in the future).

2. Why is EDUCATION important?

It is important to understand that there is no historical data available for eTA to identify predictors at this moment. However, it is possible to use some other business lines' data **as a proxy** before the launch of eTA since they collect similar information on the applicants.

We suggest using the following two data sets to evaluate the significance of the Education level indicator in making decision approved/refused for FinDec:

1. FSW for period from 2007-01-01 to 2009-01-01 (final decision date) and
2. Students (STU) for period from 2008-01-01 to 2012-21-31 (final decision date).

---

[1] Also note that this document was put together in one day, so we did not want to try to overdo it and give misleading information.

Predictor's importance and the accuracy of prediction for FinDec were assessed with and without **s.16(1)(b)**
Education levels. Note that other Education information such as study period, city and country were not **s.16(2)**
available (at least at this point) for both FSW and STU. Institution information was available only for STU
but was not used for this exercise. The results were compared and presented in the charts and tables
together with descriptive statistics illustrating the significant correlation between Education and FinDec
to confirm the importance of Education to be included in the application form.

3.1   FSW (2007-01-01 to 2009-01-01)

Predictor importance analysis and modelling were conducted on FSW data with and without education
included.

3.2   STU (2008-01-01 to 2012-21-31)

Predictor importance analysis and modelling were conducted on STU data with and without education
included.

3. Conclusion

As it was indicated above, EDUCATION level is an important predictor for the Predictive Analytics modelling process for FinDec. This is consistent with PID recommendations that include Education as a risk indicator for FSW and STU. As we could see for two lines of business, such as FSW and STU,

Since the number of indicators for the eTA automated approval process is very limited, removing such an important indicator as EDUCATION will lead to significant information lost and have an impact on Predictive Analytics accuracy.

Some descriptive statistics

a. Those who claimed refugee status before 2009 and never applied after
   i. Some of them were approved
   ii. Some of them were removed from Canada
b. Those who claimed refugee status before 2009 and made applications after
c. Those who claimed refugee status after submitting some applications

Statistics on those who claimed refugee status and have never applied for a visa

From Refugee data

The variables we have:

Statistics on those who claimed refugee status and applied for a visa after

There are 4599 clients that have had both refugee claims and applications. Of them, 3807 clients claimed refugee status before submitting any visa applications and only 792 claimed refugee status after submitting some application:

- 181– some app before, no app after
- 611 - some app before, some app after – take only some for the model

354 records with refugee claims to be analyzed for the model

Pages 351 to / à 362

are withheld pursuant to sections

sont retenues en vertu des articles

16(2), 16(1)(b)

of the Access to Information Act

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s.16(1)(b)

s.16(2)

Predictive Analytics

Predictive analytics describes the process of discovering patterns in past behavior to predict the outcome of future events. It combines computer science, statistics and operations research to drive smarter decisions by extracting actionable insights from vast quantities of data. Predictive analytics can help to prevent fraud and reduce waste by enabling the automation of manual business processes and routine decision making. Aside from the operational efficiencies gained, predictive analytics can also be used to standardize decision making processes, increasing fairness and transparency.

Timelines, Milestones, and Dependencies

Milestones for different models vary, based on individual project commitments. The following list highlights current work:

- Models for Automated triaging and auto-assignment of Express Entry applications for Fall 2015 for Phase 2 of modeling (working with real express entry data), for a roll out of a Predictive Analytics model in late spring 2016

- Business rules for triaging of eTA applications developed in February 2015 (phase 1 of the eTA work).

-

-

Operational implementation of the models is critically dependent upon integrating the team's work with that of SIMB, as data exchange with GCMS is crucial to apply the models to applications in progress.

Level of Effort
Moderate – The Data and Predictive Analytics Team, officially formed in March 2014, currently has 6.5 FTE's

A significant amount of work has been undertaken to acquire the necessary software tools and develop internal expertise.

Lead Group

- Data and Predictive Analytics Unit, Operational Performance Management Branch

Key Supporting Groups in CIC

- Solutions and Information Management Branch
- Programs, Operational Management and Coordination
- Program Integrity Division, Operational Management and Coordination
- International, Central Processing, and Domestic Regions
- Strategic Projects Office
- Performance Management Unit, Operational Performance Management Branch

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Visitor screening: accuracy necessitates complexity

The Data and Predictive Analytics Team (DPAT) attempted to improve current eTA system to screen I   by applying advanced statistical methods to data about   TRV visitors between 2010 and 2015.

DPAT investigated both of these approaches by applying advanced statistical methods to historical I   TRV data.

The first approach would be ideal, if it would be possible to create a small number of simple and accurate risk indicators to quickly flag high-risk applications. DPAT employed a type of model which is designed to generate a small number of simple rules (a "Decision List" model). We found that the rules generated by the model were simple and intuitive, but they would fail to identify a significant portion of high-risk applicants.

The second approach is to employ a predictive analytics model (C.5 decision tree).

Note: both approaches might require additional questions included in the eTA questionnaire.

Immigration, Refugees   Immigration, Réfugiés
and Citizenship Canada   et Citoyenneté Canada

Unpacking Predictive Analytics

Business Research, Intelligence and Analytics Directorate
Operations Planning and Performance Branch

March 8, 2017

Canada

What is Predictive Analytics?

Generally speaking, predictive analytics uses computers to analyze past behaviors to discover patterns that enable predictions of future behaviours.

Predictive analytics draws upon a combination of...

Using these assets, trends within data sets can be uncovered and linked to outcomes.

- Advanced Statistics
- Computer Science
- Business Expertise
- Specialized Software

An evidence-based decision making model that substantiates decisions made by human intuition.

Predictive Analytics Is Being Increasingly Used

Predictive analytics is being successfully used in the private, public, and non-profit sectors to enhance how organizations serve their clients. Some examples:

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and Citizenship Canada et Citoyenneté Canada
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Predictive Analytics at IRCC

- At IRCC, predictive models are being developed to:

    - Triage applications between high, medium and low risk.

    - Support fraud detection.
- A model is built by analyzing thousands of past applications, along with almost all other information available to officers at the time a decision is made.
- The computer analyzes how combinations of applicant characteristics correlate with approval, refusal, fraud, etc.
- The strongest and most convincing correlations are used to inform decision making.

At IRCC, predictive models are being developed to:

•

* Rather than just identify low-risk cases, we could triage all applications between high, medium and low risk.

• Support fraud detection. We're currently working on this for CIT and PP.

A model is built by analyzing thousands of past applications, along with almost all other information available to officers at the time a decision is made.

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Benefits of Predictive Analytics at IRCC

Why predictive analytics at IRCC?

- Focus on complex cases
- Strengthen program integrity
- Reduce backlogs

- Models can support program integrity directly by flagging high-risk cases for greater scrutiny.

- In the future, we will try to predict undesirable behaviour (e.g. refugee claims)

Focus on complex cases
Strengthen program integrity
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Models can also flag the highest-risk cases that merit extra scrutiny. I'll show you an example of what we're doing in this area.

In the future, we aim to predict undesirable behaviours (e.g. criminality

or refugee claims.)

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-

- A one-day pilot was conducted on December 16, 2016.

-

-

- DM and DMA were very pleased with results,

- ADM Orr has asked for an action plan before the end of March.

Example 2: Risk Triage of Spousal Sponsorships

- In June 2016, predictive models were used to perform a risk triage of the entire in-Canada spousal inventory.

- Each application was assigned a rating of high, medium or low risk, to assist officers when deciding how much scrutiny may be required.

- Among finalized applications since June, those that were identified as low risk had a refusal rate of just 4.7%, while high-risk cases had a refusal rate of 24.6%.

Refusal Rate by Risk Level

Bar chart showing: Low Risk 4.7, Medium Risk 8.6, High Risk 24.6. Average refusal rate: 8.8%
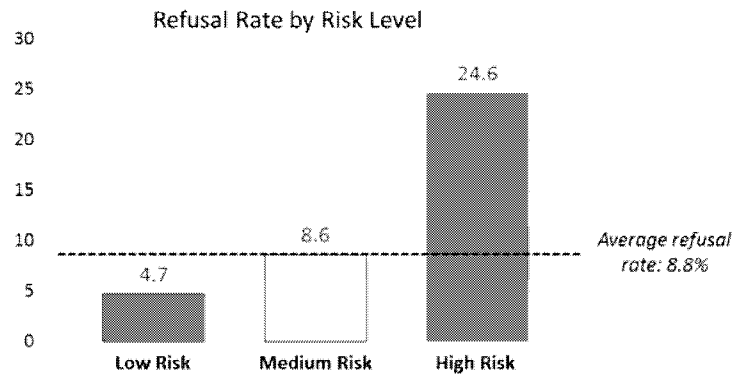
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s.16(2)

Over the past year, we've worked with PIB on a proof of concept to determine if predictive analytics can help us find risk indicators for Passport identity fraud.

The proof of concept was successful. The model was able to identify pockets of high risk people and pockets of very low risk people.

Here is an example of a risk indicator for high-risk applicants...

These findings are preliminary; this is just a proof of concept, so we're not recommending that this indicator be used in the field, but it gives an idea of the kind of patterns that a model can recognize that might not jump out to the naked eye.

We're doing something similar for CITZ

Example 4: Flagging High Risk Cases for eTA

- Predictive models can be used to strengthen program integrity by identifying high-risk cases.

- For eTA of ⬛ ationals, preliminary results suggest that a predictive model **detects more than five times as many** high-risk clients compared to quality assurance done through random selection.

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Percentage of high-risk eTA cases detected, by targeting approach

Random checks: 4.6
Predictive model: 26.0

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s.16(2)

Business Rules and Predictive Analytics

Business rules can be a great tool, but they are not the same as predictive analytics.

Suppose we're trying to identify low-risk applications:

Business Rules   Predictive Analytics

Business rules are increasingly being used to expedite processing.

A well designed business rule can be a great tool. But it's not the same as predictive analytics.

A-2018-09320-000375

Pros and Cons of Predictive Analytics Compared to Business Rules

Advantages	Drawbacks
• **Exhaustive.** Models consider how all available information correlates with the outcome. Business rules are limited by our imagination.	• **More complex.** Predictive analytics requires specialized skills and software.
• **Granularity.** Models create rules with many conditions that target very similar cases.	• **Higher upfront cost.** Models take more time and resources to create and deploy. *However:*
• **Flexibility.** Business rules that are hard-coded into a system cannot be updated regularly; models can be updated more easily.	– *IT infrastructure required for predictive models has large economies of scale and can be easily replicated across other lines of business with smaller incremental cost.*
• **Informative.** Models use probability scores to specify each the degree of risk, rather than just a "pass" or "fail".	

11

Exhaustive: Models consider how all available information correlates with the outcome. It draws on the main strength of computers, which is their ability to do millions of calculations per second. The computer will try all the combinations of applicant characteristics and see how they correlate with the predicted outcome. Business rules are limited by our imagination.

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❋

❋

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• The granularity offers potential for greater precision in targeting.

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Our Next Steps for Citizenship

- Finish developing a model identifying low-risk applications

- Run tests and simulations of the model

- Design a pilot to test the model in the real world

- If the pilot is successful, examine how the model can be integrated into the business process

For more information...

Steven Gonzalez

Assistant Director, Predictive Analytics Team

Business Research, Intelligence and Analytics Directorate (OPPB)

Steven.Gonzalez@cic.gc.ca

613-437-5556

At IRCC, predictive models are being developed to:

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* Rather than just identify low-risk cases, we could triage all applications between high, medium and low risk.

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Predictive Analytics at IRCC

Advanced and Predictive Analytics Directorate
Operations Planning and Performance Branch

October 2017

Canada

What is Predictive Analytics?

Generally speaking, predictive analytics uses computers to analyze past behaviors to discover patterns that enable predictions of future behaviours.

Predictive analytics draws upon a combination of...

Using these assets, trends within data sets can be uncovered and linked to outcomes.

- Advanced Statistics
- Computer Science
- Business Expertise
- Specialized Software

An evidence-based decision making model that substantiates decisions made by human intuition.

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Predictive Analytics at IRCC

- At IRCC, predictive models are being developed to:

  - Triage applications between high, medium and low risk.

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Overview of IRCC Predictive Analytics Projects

Senior management approved $10M over 3 years to build and deploy predictive analytics models across several lines of business.

1. Deploy models to support processing of visas and student permits for China and India, as a first step towards a global solution:
    a. Daily risk triage of applications.

2. Predictive models to support risk-triage and fraud detection for Citizenship and Passport applications.

3. Develop a Business Intelligence and Exploratory Environment (i.e. sandbox) to support the project.

Other Predictive Modeling Projects

1. Proof of concept to identify high-risk applicants and trends for Electronic Travel Authorizations (eTA).

2. Classification models to triage and centralize processing of low-risk spousal sponsorships.

3. Network analysis to link known fraudsters to other clients

4. Assessing IRCC client service using sentiment analysis (text mining)

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- A one-day pilot was conducted on December 16, 2016.

- Next pilot scheduled for October 30 to November 17, 2017

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Refusal Rate by Risk Level

Risk Level	Value
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Preliminary

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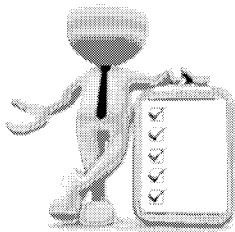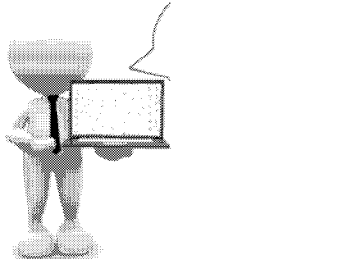## Business Rules and Predictive Analytics

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Unpacking Predictive Analytics

Business Research, Intelligence and Analytics Directorate
Operations Planning and Performance Branch

December 6, 2016

Canada

What is Predictive Analytics?

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Predictive Analytics Is Being Increasingly Used

Predictive analytics is being successfully used in the private, public, and non-profit sectors to enhance how organizations serve their clients. Some examples:

Netflix

NETFLIX

- Netflix finds viewing patterns of new customers to profit of the recommendations of a rental company that they like earlier

Vancouver Police Department

- The Vancouver Police Department uses predictive analytics to uncover crime trends and accurately predict when and where crimes are likely to occur.

Medway Youth Trust

- Medway Youth Trust (a non-profit) use predictive analytics to target interventions to students likely to experience socio-economic difficulties (e.g. truancy)

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Predictive Analytics at IRCC

- At IRCC, predictive models are being developed to:

  - Triage applications between high, medium and low risk.

  - Support fraud detection.

- A model is built by analyzing thousands of past applications, along with almost all other information available to officers at the time a decision is made.

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Local Intelligence is Critical
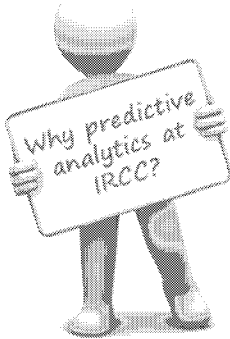
- Predictive models are not a substitute for local expertise; the two are complementary.

- Models are much more accurate when enriched by local patterns identified by officers. For example:

- It will be essential for model developers to work closely with PIB, IN, CN and DN to have the most updated intelligence.

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- A one-day field trial is planned for December 16, 2016.

- **A one-day experiment will be conducted on December 16, 2016.**

- We've already done many simulations with this model and some dress rehearsals of what would happen on the one-day experiment.

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Refusal Rate by Risk Level

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Average refusal rate: 8.8%

We've been tracking the final decisions on the inventory to see how accurate the model's triage was.

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Preliminary

Over the past year, we've worked with PIB on a proof of concept to determine if predictive analytics can help us find risk indicators for Passport identity fraud.

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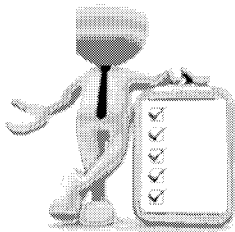
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  [illegible text] higher volumes of low or high risk cases, which generates efficiencies to recover the upfront costs over time.

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Our Next Steps
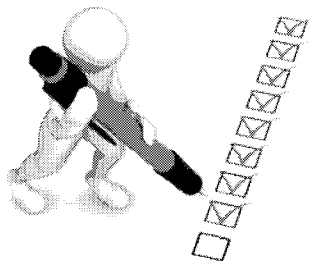
- Roll out new pilot projects to test additional models in the real world.

- Develop new predictive models for other lines of business.

- Work with the SIMB to design the IT systems required for deployment.

- Seek funding for building these IT systems.

- Keep integrating cutting-edge predictive analytics techniques.

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Predictive analytics draws upon a combination of...

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- Computer Science
- Business Expertise
- Specialized Software

The benefits of predictive analytics are...

- Supports evidence-based decision making;
- Substantiates decisions made by intuition;
- Enables faster business processes;
- Helps maximize resource output;
- Increases consistency in decision making;
- Generates synergies between business expertise and statistical analysis.

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Medway Youth Trust

- Medway Youth Trust, a UK non-profit, uses predictive analytics to target interventions to kids most likely to experience socio-economic difficulties (e.g. delinquency).

Predictive Analytics at IRCC

- In 2016, IRCC will receive more than 2 million applications from people wanting to come to Canada to study, work, or visit. For each application, officers must decide whether to approve or refuse it.

- The Data and Predictive Analytics Team (DPAT) is building predictive models designed to mimic these decisions about whether an application should be approved.

-

- DPAT works with program experts and stakeholders to understand the decision-making process, and the importance of each variable on the final decision

- To discuss best practices, DPAT has established relationships with other countries that are currently using predictive analytics   .

Predictive Analytics at IRCC

The application decision making process today...

Application arrives at IRCC	→ Application entered in system	→ Application checked for completeness	→ Applications reviewed by humans for decision

And with predictive analytics...

Application arrives at IRCC	→ Application entered in system	→ Application checked for completeness →

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Predictive Analytics at IRCC

•

• This innovative approach frees up officers to:

– Reduce any application backlogs;

– Focus on complex cases, and;

– Strengthen program integrity.

• Future uses of predictive analytics:

– Predict outcomes (e.g., who is likely to commit a crime in Canada).

– Improve workload distribution by automatically assigning cases to the appropriate officers.
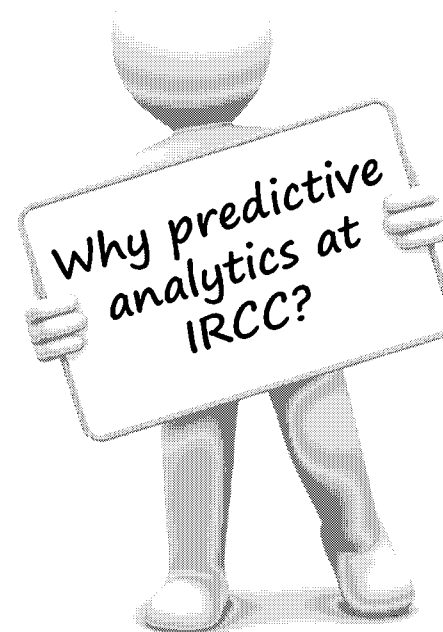
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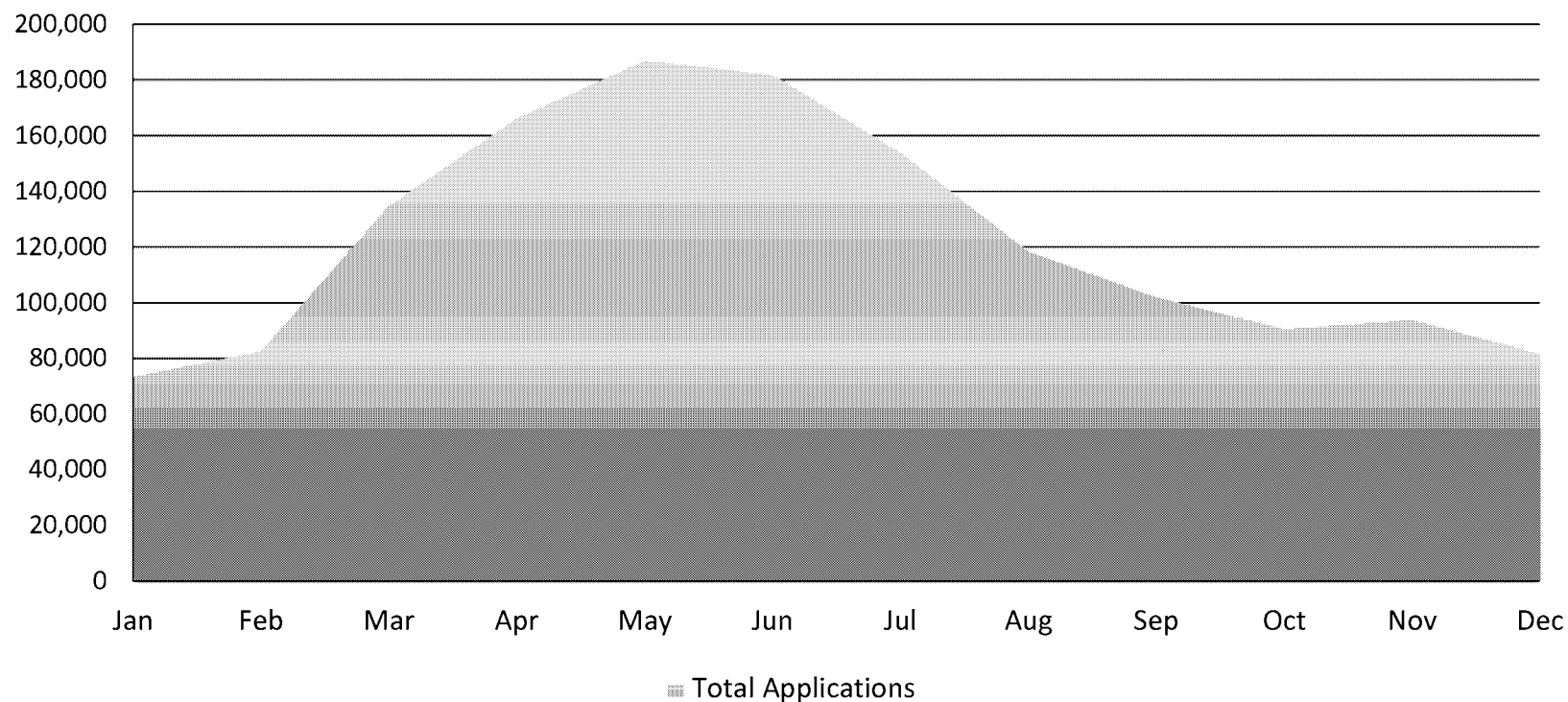
Predictive Analytics in Action

Volume of Temporary Resident Visa (TRV) Applications in 2015

Total TRVs: **1,468,000**

Total Applications

Canada

8

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Predictive Analytics in Action

Volume of Temporary Resident Visa (TRV) Applications in 2015

The model reached the same decision as officers in **98.3%** of

Total TRVs: **1,468,000**

Legend: Total Applications · I

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Predictive Analytics in Action

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Our Next Steps

- Design and build IT systems;

- Test existing models in real time, once the necessary IT systems are implemented;

- Develop new predictive models for other lines of business;

- Develop models to predict outcomes (e.g. criminal activity);

- Develop models for workload distribution;

- Keep integrating cutting edge predictive analytics techniques.

Unpacking Predictive Analytics

Business Research, Intelligence and Analytics Directorate
Operations Planning and Performance Branch

December 6, 2016

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What is Predictive Analytics?

Generally speaking, predictive analytics uses computers to analyze past behaviors to discover patterns that enable predictions of future behaviours.

Predictive analytics draws upon a combination of...

Using these assets, trends within data sets can be uncovered and linked to outcomes.

• Advanced Statistics
• Computer Science
• Business Expertise
• Specialized Software

An evidence-based decision making model that substantiates decisions made by human intuition.

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Predictive Analytics Is Being Increasingly Used

Predictive analytics is being successfully used in the private, public, and non-profit sectors to enhance how organizations serve their clients. Some examples:

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Predictive Analytics at IRCC

- At IRCC, predictive models are being developed to:

  - Triage applications between high, medium and low risk.

  - Support fraud detection.

- A model is built by analyzing thousands of past applications, along with almost all other information available to officers at the time a decision is made.

- The computer analyzes how combinations of applicant characteristics correlate with approval, refusal, fraud, etc.

- The strongest and most convincing correlations are used to inform decision making.

At IRCC, predictive models are being developed to:

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Benefits of Predictive Analytics at IRCC

Why predictive analytics at IRCC?

- Officers can be freed up to:
    - Focus on complex cases
    - Strengthen program integrity
    - Reduce backlogs

- Models can support program integrity directly by flagging high-risk cases for greater scrutiny.

- In the future, we will try to predict undesirable behaviour (e.g. criminality)

Focus on complex cases
Strengthen program integrity
Reduce backlogs

Models can also flag the highest-risk cases that merit extra scrutiny. I'll show you an example of what we're doing in this area.

In the future, we aim to predict undesirable behaviours (e.g. criminality

or refugee claims.)

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- A one-day field trial is planned for December 16, 2016.

- Simulations to date:

•

- **A one-day experiment will be conducted on December 16, 2016.**

*

*

- We've already done many simulations with this model and some dress rehearsals of what would happen on the one-day experiment.

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Example 2: Risk Triage of Spousal Sponsorships

- In June 2016, predictive models were used to perform a risk triage of the entire in-Canada spousal inventory.

- Each application was assigned a rating of high, medium or low risk, to assist officers when deciding how much scrutiny may be required.

- Among finalized applications since June, those that were identified as low risk had a refusal rate of just 4.7%, while high-risk cases had a refusal rate of 24.6%.

Refusal Rate by Risk Level

We've been tracking the final decisions on the inventory to see how accurate the model's triage was.

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Over the past year, we've worked with PIB on a proof of concept to determine if predictive analytics can help us find risk indicators for Passport identity fraud.

The proof of concept was successful. The model was able to identify pockets of high risk people and pockets of very low risk people.

Here is an example of a risk indicator for high-risk applicants...

These findings are preliminary; this is just a proof of concept, so we're not recommending that this indicator be used in the field, but it gives an idea of the kind of patterns that a model can recognize that might not jump out to the naked eye.

We're doing something similar for CITZ

Example 4: Flagging High Risk Cases for eTA

- Predictive models can be used to strengthen program integrity by identifying high-risk cases.

- For eTA of _____ nationals, preliminary results suggest that a predictive model **detects more than five times as many** high-risk clients compared to quality assurance done through random selection.

- Better targeting can increase the "hit rate" and reduce the amount of resources dedicated to screening.

Percentage of high-risk   eTA cases detected, by targeting approach

Targeting approach	Percentage
Random checks	4.6
Predictive model	26.0

My last example pertains to ETA. As you're probably aware, _____ was a big day for ETA because _____ became _____ visit Canada.

_____ PIB has asked us to work with them to identify indicators of high-risk applications that should drop out of the automated process and be manually reviewed.

Based on very preliminary work, if we used a model to pick high risk applications, about 1 in 4 would be from a client for whom we would refuse entry into Canada. That's much higher than if we just picked applications randomly, in which case less than 5% would be refused entry.

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Business rules are increasingly being used to expedite processing.

A well designed business rule can be a great tool. But it's not the same as predictive analytics.

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Pros and Cons of Predictive Analytics Compared to Business Rules

Advantages

- **Exhaustive.** Models consider how all available information correlates with the outcome. Business rules are limited by our imagination.

- **Granularity.** Models create rules with many conditions that target very similar cases.

- **Flexibility.** Business rules that are hard-coded into a system cannot be updated regularly; models can be updated more easily.

- **Informative.** Models use probability scores to specify each the degree of risk, rather than just a "pass" or "fail".

Drawbacks

- **More complex.** Predictive analytics requires specialized skills and software.

- **Higher upfront cost.** Models take more time and resources to create and deploy. *However:*

  – *IT infrastructure required for predictive models has large economies of scale and can be easily replicated across other lines of business with smaller incremental cost.*

  models detect higher volumes of low- or high- risk cases, which generates efficiencies to recover the upfront cost over time.

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Exhaustive: Models consider how all available information correlates with the outcome. It draws on the main strength of computers, which is their ability to do millions of calculations per second. The computer will try all the combinations of applicant characteristics and see how they correlate with the predicted outcome. Business rules are limited by our imagination.

Granularity:
- Models create rules with many conditions that target very similar cases.
*

*

*

- The granularity offers potential for greater precision in targeting.

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Our Next Steps

- Roll out new pilot projects to test additional models in the real world.

- Develop new predictive models for other lines of business.

- Design models to predict specific outcomes (e.g. criminal activity).

- Work with the SIMB to design the IT systems required for deployment.

- Seek funding for building these IT systems.

- Keep integrating cutting-edge predictive analytics techniques.

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For more information...

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Unpacking Predictive Analytics

Business Research, Intelligence and Analytics Directorate
Operations Planning and Performance Branch

May 5, 2017

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Predictive Analytics at IRCC

- At IRCC, predictive models are being developed to:

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The computer analyzes how combinations of applicant characteristics correlate with approval, refusal, fraud, etc.

The strongest and most convincing correlations are used to inform decision making. The best correlations are tested extensively on data that the model has never seen, to determine if the model's insights are reliable and can be generalized to other cases.

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Benefits of Predictive Analytics at IRCC

Why predictive analytics at IRCC?

- Focus on complex cases
- Strengthen program integrity
- Reduce backlogs

- Flagging high-risk cases supports program integrity more directly by making sure that these cases do not fall through the cracks.

- We are beginning to predict undesirable behaviour (e.g. removal orders)

Focus on complex cases
Strengthen program integrity
Reduce backlogs

Models can also flag the highest-risk cases that merit extra scrutiny.

We are beginning to predict undesirable behaviours (e.g. removal orders)

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- A one-day pilot was conducted on December 16, 2016.

    - The quality of the model decisions seems good (avoiding adverse outcomes)

- DM and DMA were very pleased with results,

- ADM Orr has asked for implementation before the 2018 peak season.

The DM and DMA were briefed on the results. They were very pleased and would like us to press forward on this.

The ADM of Operations has asked for implementation before the 2018
peak season for China.

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The pilot was for applications received via a VAC. However, IN has requested that we focus on e-apps, so the rest of the discussion focusses on our new model for TRVs received via e-apps

Database: Jan 2015 to February 2017
According to section 42 of IRPA, if a person is inadmissible to Canada, their family members could also be inadmissible.

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Example 1: Data Sources for China Model

Consent clause on application for temporary resident visa (TRV):

I consent to the release to Citizenship and Immigration Canada (CIC) and Canada Border Services Agency (CBSA) of all records and information for the purpose of processing my request that any government authority, including police, judicial and state authorities in all countries in which I have lived may possess about me. This information will be used to evaluate my suitability for admission to Canada or to remain in Canada pursuant to Canadian legislation.

The model finds people that have very similar characteristics and very similar outcomes in terms of decisions from our officers.

Related parties: includes family members, other people traveling with the client as a group, and the inviter.

* You may recall that section 42 of IRPA states that a person may be inadmissible into Canada if one of their family members is inadmissible.

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Example 2: Risk Triage of Spousal Sponsorships

- A predictive model was built to identify low-risk spousal sponsorships that could be granted streamlined processing.

- The data used to build the model covered roughly 100,000 applications.

- The data used is similar to the China model, but we have information about both the sponsor and the principal applicant:

- All of this information is already collected under current operating procedures and is already used by officers when adjudicating applications.

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Example 2: Risk Triage of Spousal Sponsorships

- The model generated many rules grouping very similar applicants, as in the China example.

- This triage rule is currently being piloted in Manila and New Delhi.

Philippines and India are among the lower-risk countries for this line of business, among visa-required countries. We also wanted to limit the pilot to a small number of offices.

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Data Governance and Legal Risks

- Section 6(2) of the *Privacy Act* requires that all reasonable steps be taken to ensure that personal information used for administrative decisions is as accurate, up-to-date and complete as possible.

- This presupposed a certain quality of data in GCMS and other systems.

- We know that data quality problems already exist at IRCC

  ➢ This could create legal risks for current manual processing, before predictive analytics is ever deployed.

- OPP has a **Data Governance Team** dedicated to working with branches across IRCC to ensure high quality data.

- This work deserves greater emphasis regardless of the future of predictive analytics.

But I want to make sure that we don't lose sight of a legal consideration that pre-dates predictive analytics and affects how IRCC currently does business. I'm talking about Data Governance or data quality.

Example: duplicate UCI: to qualify for some programs, you need experience with another program. CEC requires previous work experience in Canada, hence a WP. If the WP is on one UCI and the CEC application on another, the person may not appear eligible.

Next Steps for Predictive Analytics
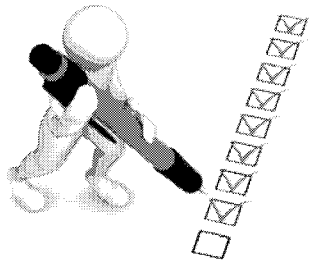
- Continue developing models identifying low-risk applications
  - Focus on TRV, student permits and spousal sponsorships
- Continue developing models to identify high-risk cases
  - Focus on eTA, Citizenship and Passport
- A new China TRV pilot is forthcoming; India TRV to follow.
- Work with SIMB to deploy China model by February 2018; India to follow later in 2018.

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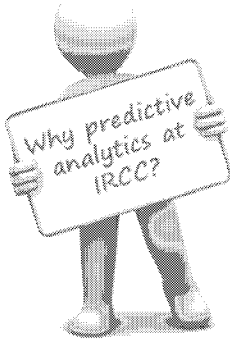
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ANNEX

16

Business rules are increasingly being used to expedite processing.

A well designed business rule can be a great tool. But it's not the same as predictive analytics.

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Pros and Cons of Predictive Analytics Compared to Business Rules

Advantages	Drawbacks
• **Exhaustive.** Models consider how all available information correlates with the outcome. Business rules are limited by our imagination.	• **More complex.** Predictive analytics requires specialized skills and software.
• **Granularity.** Models create rules with many conditions that target very similar cases.	• **Higher upfront cost.** Models take more time and resources to create and deploy. *However:*
• **Flexibility.** Business rules that are hard-coded into a system cannot be updated regularly; models can be updated more easily.	– *IT infrastructure required for predictive models has large economies of scale and can be easily replicated across other lines of business with smaller incremental cost.*
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Granularity:
•   Models create rules with many conditions that target very similar cases.
❋

❋

❋

•   The granularity offers potential for greater precision in targeting.

Predictive Analytics for ETA

Business Context

Pick out low risk travellers from visa required countries; allow them to apply for an eTA (electronic travel authorization) instead of a TRV (temporary resident visa).

Eligibility: candidate was previously issued a Canadian TRV within the last ten years; or holds a valid U.S. non-immigrant visa

Pilot project for low risk   travellers in 2015; will be rolled out globally eventually

Lab data available: 324,530 TRV applications from   citizens, between 2008 and 2012

36 fields for each record

Data cleansing: deal with missing values and outliers; remove fields that have a high percentage of unknown data

Modeling

Decision tree

Chart?

How to pilot the model

How the model can be tested in the real world in a zero risk fashion

What results are we looking for in order to improve the model?

Deployment plans

Integration with application (GCMS)?

Change management – what business processes will change?

Risk management – if something goes wrong

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Citizenship and Immigration Canada

Predictive Modeling for Express Entry

OPMB-PMU-DPAT

October 2014

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Concrete benefits in any business doing predictive analytics (Walmart, for example, or Googles, that both use that now in their business to save money, profile their consumers and improve resource allocations)

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:

* Increasing processing capacity

* Facilitate program integrity exercises
* Deliver optimal client service

Data Analytics: out reach

Data Analytics Working Groups
predictive analytics demands tight collaboration with partners and the business
We started the WG in collaboration with PID. We co-chair.

Data Analytics Coalition
Great forum for sharing ideas and best practices as predictive analytics is relatively new to the federal government
Similar goals – workload distribution
Common challenges – change management, setting users expectations, poor data quality

Express Entry- Data Exploration

- Original data set had 547,215 applications with 122 unique fields

  - ➤ Federal Skilled Worker Program (FSW)— - **72.13%**
  - ➤ Provincial/Territorial Nominees (P/N) - **21.16%**
  - ➤ Canadian Experience Class (CEC) - **6.69%**
  - ➤ Skilled Trades (ST) - **0.03%**

Distribution by Programs

Skilled Workers	72.13	394689
Provincial/Territorial Nominees	21.16	115772
Canadian Experience Class	6.69	36590
Skilled Trades	0.03	164

- Missing values and outliers were removed from the data for each LOB
- As a result, each LOB has reduced number of records
- Time periods for modeling were also chosen for each LOB depending on availability and quality of the data

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For FSW, DPAT analyzed data for FSW before and after MI. As a result, before MI data was chosen for FSW. This decision was based on business knowledge and opinion on which cases should be included in the sample in the way that there would not be any lost in representativeness of our future population of applications, while preserving the quality of the data set. The fact that Express Entry does not have MI restrictions is also consistent with this choice of pre-MI time period for modeling.

For PN, data was analyzed for GCMS and CAIPS separately due to some missing values problem.   since both sets of data yield the same acceptance rate and adding more applications to build the model results in a higher degree of freedom leading to increased robustness. Thus helping to ensure that the model performs as expected (i.e. is not over-fitted).

For CEC, WG suggested that DPAT use only GCMS data from 2011 to 2014-07-04 (final decision date) given all the missing values in CAIPS.

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Express Entry- Predictive Indicators and Model

- DPAT used Auto data Preparation method to identify the most important predictors for making decision to approve or refuse the application.

- DPAT have looked at different prediction methods, such as Decision Trees (i.e C5.0, CHIAD...) and Logistic Regression.

- After developing models based on each of these methodologies, we compare the overall accuracy rate, discuss the results with the clients and select the method with the highest possible accuracy rate that meets CIC's needs.

It is important to focus our modeling on the fields/indicators that matter the most and consider dropping those that matter least. Predictor importance does not relate to model accuracy. It chooses among available 122 fields

The predictive power (non-weighted) of each recommended predictor is computed by Auto Data Preparation (ADP) from either a linear regression or naïve Bayes model, depending upon whether the target is continuous or categorical. In our case, the target FinDec is categorical so that Bayes naive model was used by ADP.

The Bayes model is termed *naïve* because it treats all proposed prediction variables as being independent of one another. This is why we used naive Bayes model only for initial selection of predictors.

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Future Triaging Through Predictive Analytics

- Each Express Entry application coming trough will be assessed and scored against predictors and as per the model that was developed and will be re-validated before implementation.

- The predictive model breaks down the Express Entry case-load into **3 Bins:**

  - Level one decision makers
  - Level two decision makers
  - Level three decision makers

- Cases in the Green Bin and Red Bin (applications scored with most certainty) will go to in --Level one and Level two decision makers;

- Cases in Yellow Bin (cases with some uncertainty) will go to Level three decision makers.

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The *probability bins* like *exam marks*. Red and Green bins are *passing mark*s for applications to be processed in Canada. There will be certain number of applications that pass this mark. This number of applications depends on the threshold (in our case 85% for PN and CEC and 80% for FSW) that is established in agreement with business and our partners.

For CEC, 99% applications is processed in Canada so that cases corresponding to Yellow bin will go for the additional QA.

For FWS, PN, CEC was used C5.0. algorithm to develop the models. Each of these LOB has different output for probability bins.

For FSW,

(
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For PN,

For CEC,

For FSW,

There were 39.2% of cases to be referenced since the probability P for FinDec to be correct was less than 80% or the prediction was biased.

For PN,

There were 31.2% of cases to be referenced since the probability P for FinDec to be correct was less than 80% or the prediction was biased.

For CEC,

There were 3.4% of cases to be referenced since the probability P for FinDec to be correct was less than 80% or the prediction was biased. It is expected that business and our partners will tell us what the future plans are for the split in processing for CEC.

•For Phase I, this is about November, 2014

•For Phase II, this is about 6-9 months after launching Express Entry in January, 2015 when Express Entry data will be available

•Then it will be ongoing maintenance (monitoring, revision if needed) of the model

Details:

•It is anticipated to restart WG after receiving Express Entry data.

•The current triage rules and risk profiles are based on the subjective input of visa officers.
•The future plan is to make these rules exhaustive and evidence-based.

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Concrete benefits in any business doing predictive analytics (Walmart, for example, or Googles, that both use that now in their business to save money, profile their consumers and improve resource allocations)

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:

* Increasing processing capacity

* Facilitate program integrity exercises
* Deliver optimal client service

Data Analytics: out reach

Data Analytics Working Groups
predictive analytics demands tight collaboration with partners and the business
We started the WG in collaboration with PID. We co-chair.

Data Analytics Coalition
Great forum for sharing ideas and best practices as predictive analytics is relatively new to the federal government
Similar goals – workload distribution
Common challenges – change management, setting users expectations, poor data quality

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Express Entry- Data Exploration

•Original data set had 547,215 applications with 122 unique fields

➢ Federal Skilled Worker Program (FSW)– - **72.13%**
➢ Provincial/Territorial Nominees (P/N) - **21.16%**
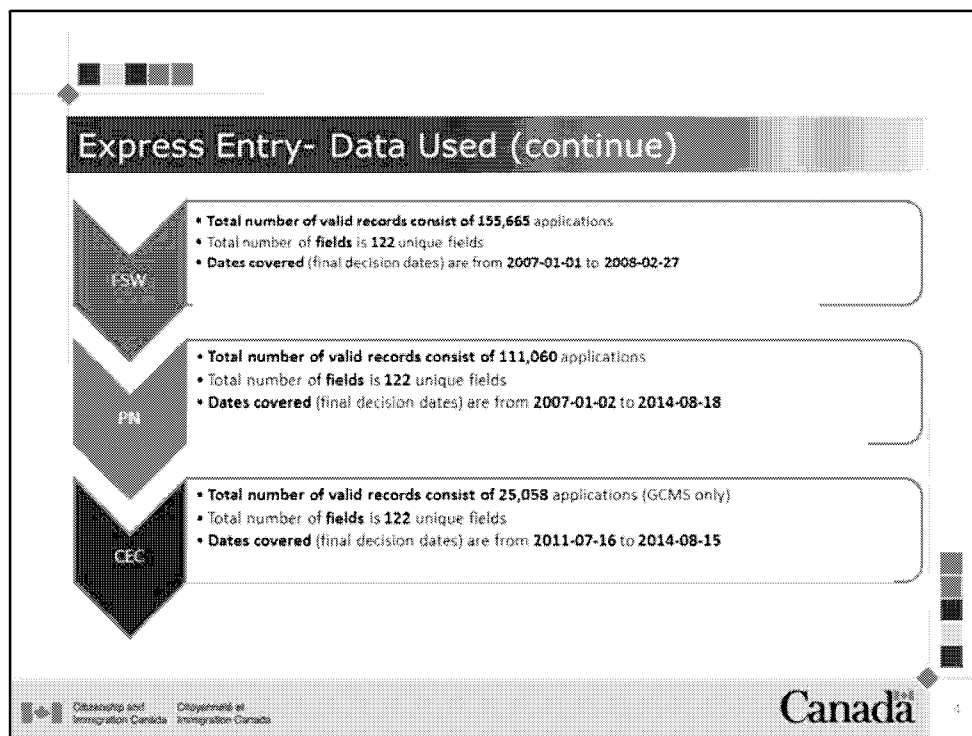➢ Canadian Experience Class (CEC) - **6.69%**
➢ Skilled Trades (ST) - **0.03%**

Distribution by Programs

Skilled Workers	72.13	394689
Provincial/Territorial Nominees	21.16	115772
Canadian Experience Class	6.69	36590
Skilled Trades	0.03	164

• Missing values and outliers were removed from the data for each LOB
• As a result, each LOB has reduced number of records
• Time periods for modeling were also chosen for each LOB depending on availability and quality of the data

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Immigration Canada   Immigration Canada

Canada

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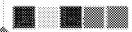
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For FSW, DPAT analyzed data for FSW before and after MI. As a result, before MI data was chosen for FSW. This decision was based on business knowledge and opinion on which cases should be included in the sample in the way that there would not be any lost in representativeness of our future population of applications, while preserving the quality of the data set. The fact that Express Entry does not have MI restrictions is also consistent with this choice of pre-MI time period for modeling.

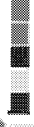**For PN**, data was analyzed for GCMS and CAIPS separately due to some missing values problem.   since both sets of data yield the same acceptance rate and adding more applications to build the model results in a higher degree of freedom leading to increased robustness. Thus helping to ensure that the model performs as expected (i.e. is not over-fitted).

For CEC, WG suggested that DPAT use only GCMS data from 2011 to 2014-07-04 (final decision date) given all the missing values in CAIPS.

It is important to focus our modeling on the fields/indicators that matter the most and consider dropping those that matter least. Predictor importance does not relate to model accuracy.

The predictive power (non-weighted) of each recommended predictor is computed by Auto Data Preparation (ADP) from either a linear regression or naïve Bayes model, depending upon whether the target is continuous or categorical. In our case, the target FinDec is categorical so that Bayes naive model was used by ADP.

The Bayes model is termed *naïve* because it treats all proposed prediction variables as being independent of one another. This is why we used naive Bayes model only for initial selection of predictors.

Scores and models are not everything:

The placement of the business rules might change after we have come up with a Solution (IT) as this is just tentative for now.

Complexity will be added in the future to the Predictive Models, in order to do complete complexity and risk-based triaging.

Quality Assurance is a random selection of XX% of cases for QA, assigned to QA group.

Workloads Distribution: Each bin can be assigned to officers according to operational requirements, expertise, levels, etc.

Triage Model Validation: A random selection of cases from bin #1 and # 2 will be assigned to officers at superior levels to ensure that:

Higher ranking officers remain exposed to all types of case.

Senior officers can continuously validate the Triage model.

Experienced officers can confirming that cases were effectively assigned to the right bin by the Triage model.

Experienced field officers can detect errors in the Triage model.

Experienced field officers can provide intelligence to centralised offices and HQ in order to improve and rafine the Triage model.

Note:

For FSW, PN, CEC was used C5.0. algorithm to develop the models. Each of these LOB has different output for probability bins.

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•For Phase I, this is about November, 2014

•For Phase II, this is about 6-9 months after launching Express Entry in January, 2015 when Express Entry data will be available

•Then it will be ongoing maintenance (monitoring, revision if needed) of the model

Details:

•It is anticipated to restart WG after receiving Express Entry data.

•The current triage rules and risk profiles are based on the subjective input of visa officers.
•The future plan is to make these rules exhaustive and evidence-based.

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OVERVIEW: IRCC Predictive Analytics Projects

Senior management approved $10M over 3 years to build and deploy predictive analytics models and forecasting models across several lines of business.
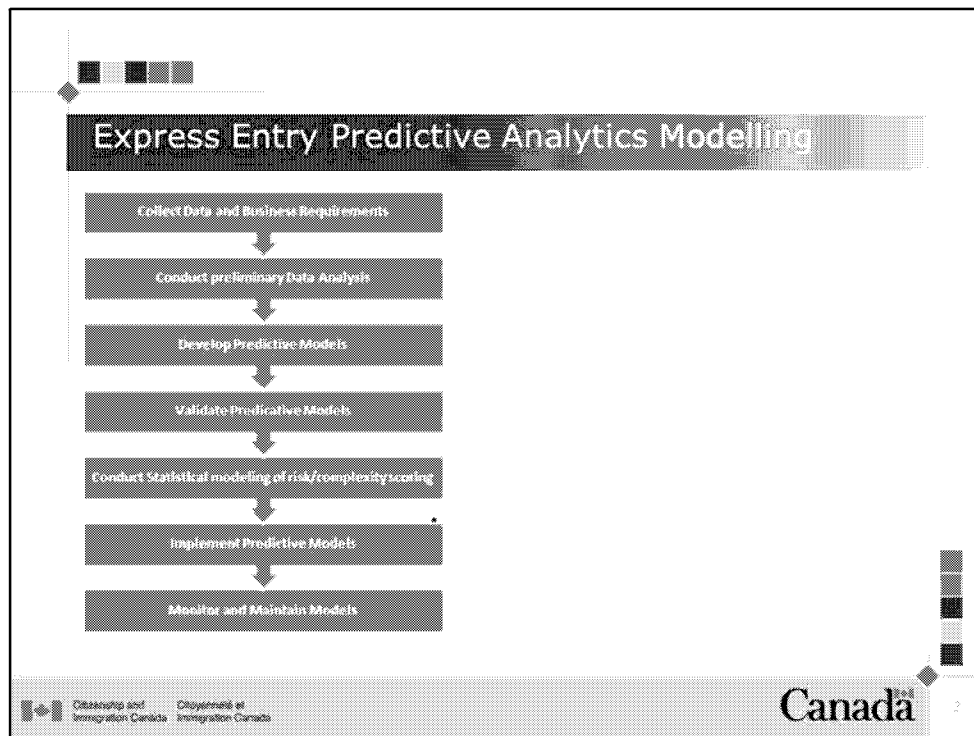
1. Deploy predictive models to support processing of visitor visas and student permits for China and India nationals (submitted online), as a first step towards a global solution:
    a. Daily risk triage of applications.
    b.

2. Predictive models to support risk-triage and fraud detection for Citizenship and Passport applications.

3. Develop forecasting models for several lines of business (visitor visas, student permits, work permits, Citizenship Grants, Permanent Resident Cards).

4. Develop a Business Intelligence (BI) and Exploratory Environment (i.e. Advanced Analytics sandbox) to support the project.

Other Predictive Modeling Projects

1. Proof of concept to identify high-risk applicants and trends for electronic travel authorizations (eTA).

2. Classification models to triage and centralize processing of low-risk spousal sponsorships.

3. Assessing IRCC client service performance (sentiment analysis)

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CASE STUDY

CHINA TEMPORARY RESIDENT VISA DEPLOYMENT (2018)

2

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Deploying Predictive Models: Temporary Resident Visas

*

* A model analyzes thousands of past officer decisions, along with most of the information available to officers at the time the decision was made.

* Triage into roughly three groups:

Model for China visitor visas to be deployed in February 2018.

Other predictive models to be deployed by late 2018.

3

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Ideally, a predictive model would be integrated within GCMS as follows. This is the fully automated system that has been discussed for a few years, dating back to the Integrated Network Project.

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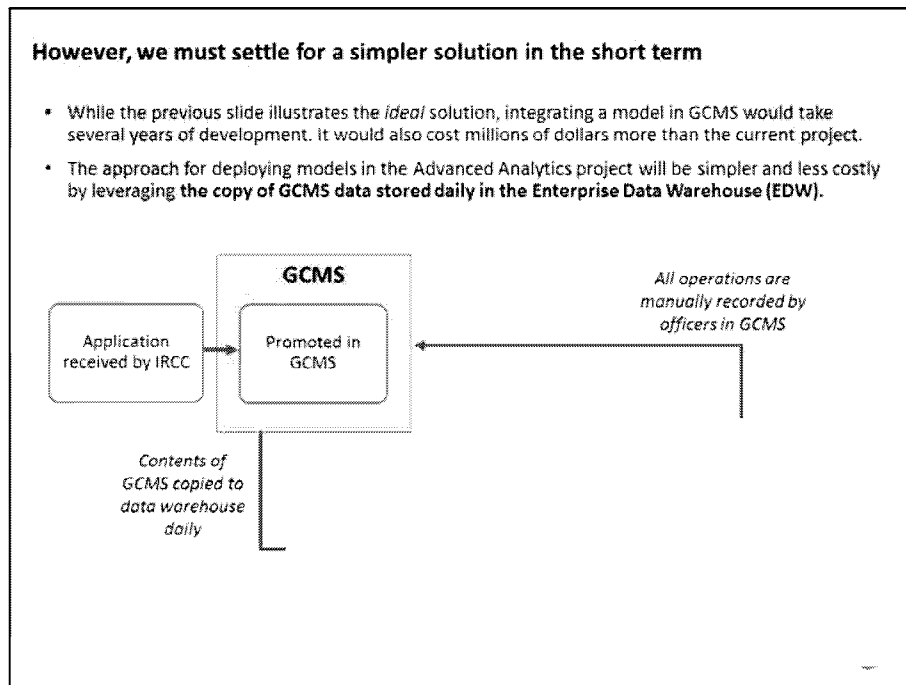
We can't do this ideal system because of the issue of admissibility assessments, but also because such a system would be very costly and take years to implement.

EDW came up with a clever alternative for deployment which is simpler and less costly. It leverages **the copy of GCMS data stored daily in the Data Warehouse (EDW).**

Very important to keep in mind: Because the model cannot interact with GCMS, it cannot make any changes to applications on its own; officer intervention will be required.

- **That also means that the results of the risk triage (e.g. colour of the bin) will not be stored in GCMS unless IN or CN see fit to ask officers to enter that information somewhere.**

- **EDW will maintain a copy of the results of the risk triage, so it will always be possible for us to go back and review how applications were triaged and prepare reports on this.**

- **Maybe we can make the risk triage available in Answers or Cognos so that you can**

prepare reports.

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Customizing the model's output for officers

The output from the model need not be limited to the colour of the bin. We can add other information to reduce clicks in case management system. For example:

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For example, for each application, we can display:

We can incorporate this quite easily into the report received by each office. But we don't want to overload officers with too much information either. Tell us what would be useful and we'll make it happen.

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ELECTRONIC TRAVEL AUTHORIZATION (PROOF OF CONCEPT)

Proof of Concept risk assessment system in development

*   Predicts applicant likelihood of future adverse events.
*   Long-term working concept is to flag a small number of high-risk applications for additional review by human officers.
*   Short-term, same system enables identification of risk factors and potential fraud trends.

Initial model prediction results are encouraging...suggests some "low-hanging" high-risk cases.
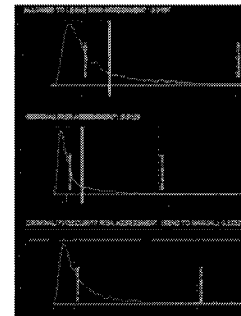
Several eTA-specific challenges:

1. Limited organizational capacity to expand manual review of eTAs
2. Light touch program that collects little data about mostly low-risk visitors
3. Program design necessitates streaming/real-time scoring
4. Extreme rare event targeting (often fewer than 1 in 1000 target cases)

eTA Risk Scoring and Fraud Detection Tool

Mike Haymes, Advanced Analytics Lab
April 2018

PRELIMINARIES

FOR INTERNAL USE ONLY.

eTA Risk Scoring and Fraud Detection Tool

- AAL has built a tool to identify fraud and risk trends within large volumes of raw eTA data.

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- Developed as an IRCC contribution to the Chain of Trust Collaborative R&D Project.

The Goal: "Eat the haystack, spit out the needles"

4/20

What does it do?

- Efficient algorithm for mining through millions of eTAs to identify high-risk groups/characteristics.

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Use Cases at IRCC

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The Million Dollar Question

Does it work?

Yes!

The Better Question: Does it work well enough to support operational requirements?

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Succesful Proofs of Concept (to Date)

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Scoring Engine

· Demonstrated as a real-time risk scoring engine for Chain of Trust Project

· Relatively promising results as prediction engine for extremely rare events

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Limitations

· Rules generated by the system are "messy"

· Requires a lot of manual tuning to get the right level of risk (model development only)

· Computationally expensive

· Manual validation required when risks are identified

· Scoring for extremely rare events

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Next Steps

- Ongoing data improvements

- Need to streamline data preparation and cleaning

- Potential "silent pilot" to provide a robust test of the risk-scoring element

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QUESTIONS

Questions?

Thoughts?

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A-2018-09320-000487

Main Dataset

- **Number of records:** 120,114
- **Dates covered:** PA final decision date from 2013-01-02 to 2017-01-13
- **Number of fields:** 158

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Stats on Family Class

Applications finalized in 2013-2015

Total applications: 142,892

Application Category

Value	Proportion	%	Count
FC1		91.66	130978
FCC		7.64	10913
FCE		0.7	1001

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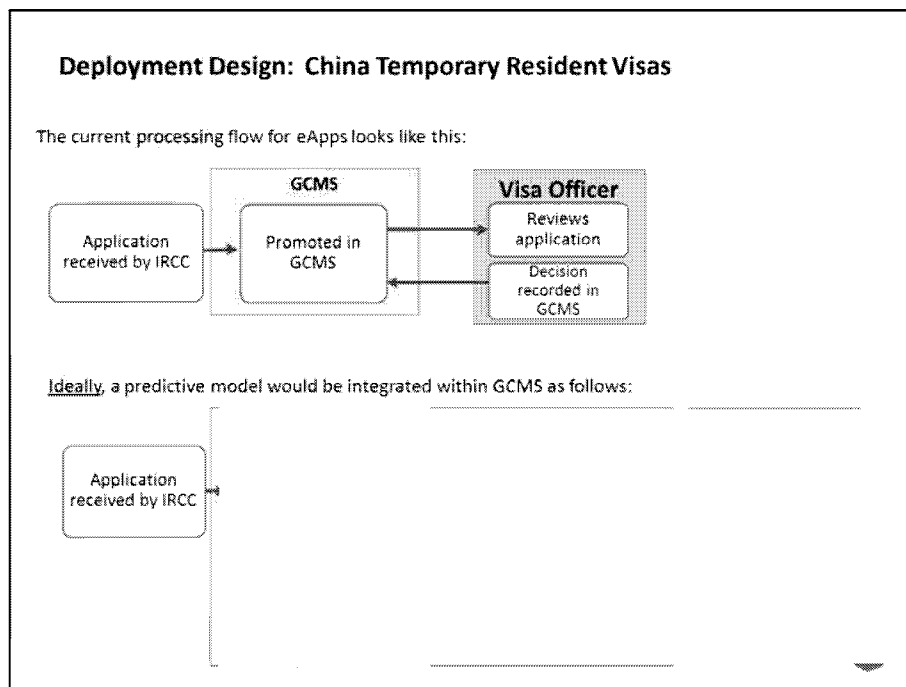
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Data and Predictive Analytics: Opportunities for CIC

May, 2015

Done by DPAT, for Updating Senior Man

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1.0   Introduction

The term "predictive analytics" describes the process of discovering patterns in past behavior to predict the outcome of future events. **It combines applied computer science, statistics and operations research to drive smarter decisions by extracting actionable insights** from the vast quantities of data captured by government departments. At CIC, a handful of projects that enable the use of predictive analytics are underway; these projects have a formal project plan and schedule in place and have funding provided by Memorandum to Cabinet (MC) and Treasury Board submissions (see Annex 3 for overview of the DPAT projects and under which funding envelop they are funded).

DPAT projects for Temporary and Permanent Resident lines of business are:
1. Express Entry (Phase 1 & 2)
2. ETA (Phase 1 & 2)
3. IN Project:
    a. TR pilot (VR-Extension, International Experience Canada (IEC), Student
    b. Full TR (All TR's; i.e.TFW/LCP, Temporary Resident Visa (TRV)and Study permit)

Predictive analytics maximizes the Department's resources, helps prevent fraud, and enhances client service.

Predictive analytics will reduce the labour intensity of application triaging and processing as well as minimize the time to a decision for a significant number of cases.

2.0   Why Predictive Analytics in OPMB?

OPMB-PMU has a great experience in Business Intelligence (BI); providing deep, sophisticated analytics on large volumes of actual and historical data. OPMB-PMU BI tools (such as Cognos10, SPSS and R) run advanced analytics that were previously impossible or impractical. OPMB-PMU BI consolidates all analytics activity to where the data resides, enabling CIC to react quickly and accurately on urgent requests and operational changes. Finally, OPMB-PMU has **network wide experience in workload distribution** and in providing information to all parts of the Operations Sector. This makes housing Predictive Analytics within OPMB strategically imperative.

Currently, CIC makes use of Dashboards both inside and outside of GCMS Answers, in order to maintain workload distribution and program integrity. Other areas in CIC have developed similar tools. While these areas can be large parts of the network, they are not network wide, nor do they have the integrated historical information that OPMB has available to it. This adds strategic importance to housing Predictive Analytics in OPMB; it has more information on hand to not only perform network wide data mining, but to also perform longitudinal data mining. This is critical: the more application and longitudinal information missing in the data, the greater chance there is that important application profiles are missed. OPMB has far fewer limitations on what it can achieve with Predictive Analytics than any other area in the Operations sector.

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OPMB is unbiased in the face of resource re-allocation, as it does not have any resources physically performing operations. Bias is the bane of all information analysis. We cannot also neglect the fact that advanced predictive analytics users and groups that have deployed models into production are all adamant about the crucial need to have the predictive analytics function sitting in the business group, without being run and managed by the clients themselves[1].

Figure 1 - Data Science
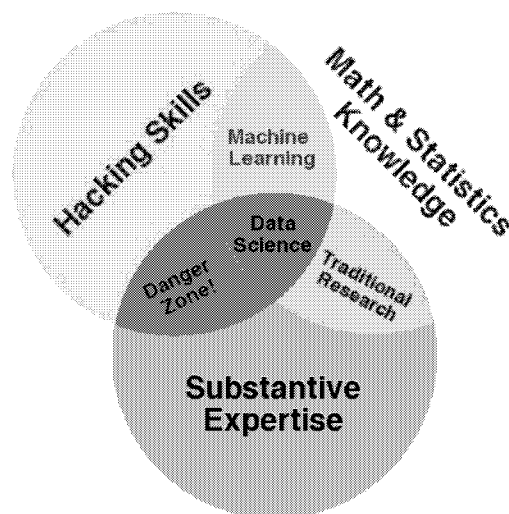
Note: Hacking skills are defined as the ability to make software produce the best result (i.e. thinking "outside of the box"; frequent testing).

3.0   DPAT Commitments and Resources

3.1   Funding:

Funding to develop Predictive Analytics capacity and function in CIC has been provided by Memorandums to Cabinet – TB submissions. Some funds are temporary (some of Express Entry for example), with others will be ongoing for delivering projects and establishing an ongoing predictive analytics function within CIC so that models can be maintained through regular monitoring and improvement.

DPAT currently has slightly over $800,000[2] for each of the first few years to establish the team and the function, and the ongoing funding is expected to be approximately $700,000[3]. Of note, though that the IN Project is currently expanding beyond TR, and DPAT did not receive funding for work beyond TR and a few PR lines. The project and ongoing funding might may change in the near future.

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[1] (See Predictive Analytics Trip Report from Washington)
[2] For the current projects.
[3] Of note, the USA as well as other countries, has a budget of millions for the similar teams and functionalities.

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3.2   Team:

The team was officially formed in March 2014; first with two full-time resources, now with 6.5. The team will soon to be expanded to 8.5 full-time resources.

4.0   Update on DPAT Projects, as of March 2015

4.1   Express Entry

DPAT uses evidence-based indicators and works with other divisions such as OMC (PID, PRPD, TRPD), CPR, SPP-Admissibility, IR and SPO.

Express Entry predictive analytics work has **two phases**. For **Express Entry Phase 1, completed in Dec 2014**, the DPAT used proxy data to develop models and business rules. The DPAT worked closely with OMC (PRPD and PID) as well as with SPO, IR and CPR, to provide data and validation exercises for the business rules to be used at launch for triaging and assignment of Express Entry Applications. Business (OMC) now uses the rules that we developed in cooperation with the DPAT to process Express Entry cases.

The DPAT will soon be working with CPR and Operations to use the rules to a deeper level by using GCMS Answers to create dashboards that will allow applications to be grouped and assigned, using the dashboard. Work has started in DPAT, and a first meeting was held with CPR[4].

After the launch of Express Entry in January 2015, the DPAT is now waiting for few months to collect real data and validate or re-build the models based on proxy data. **Once enough EE applications are finalized for development of predictive models, Express Entry phase-2 will start.** An Express Entry model is expected by late Fall 2015 for implementation, and production for auto-triaging by the spring of 2016 (pending technical solution date and details).

See Figure 2 (below) for illustration of what we could do when we have integration with processing system:

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[4] See the Express Entry update deck

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Figure 2 - Express Entry Future Triaging Through Predictive Analytics

Business Rules
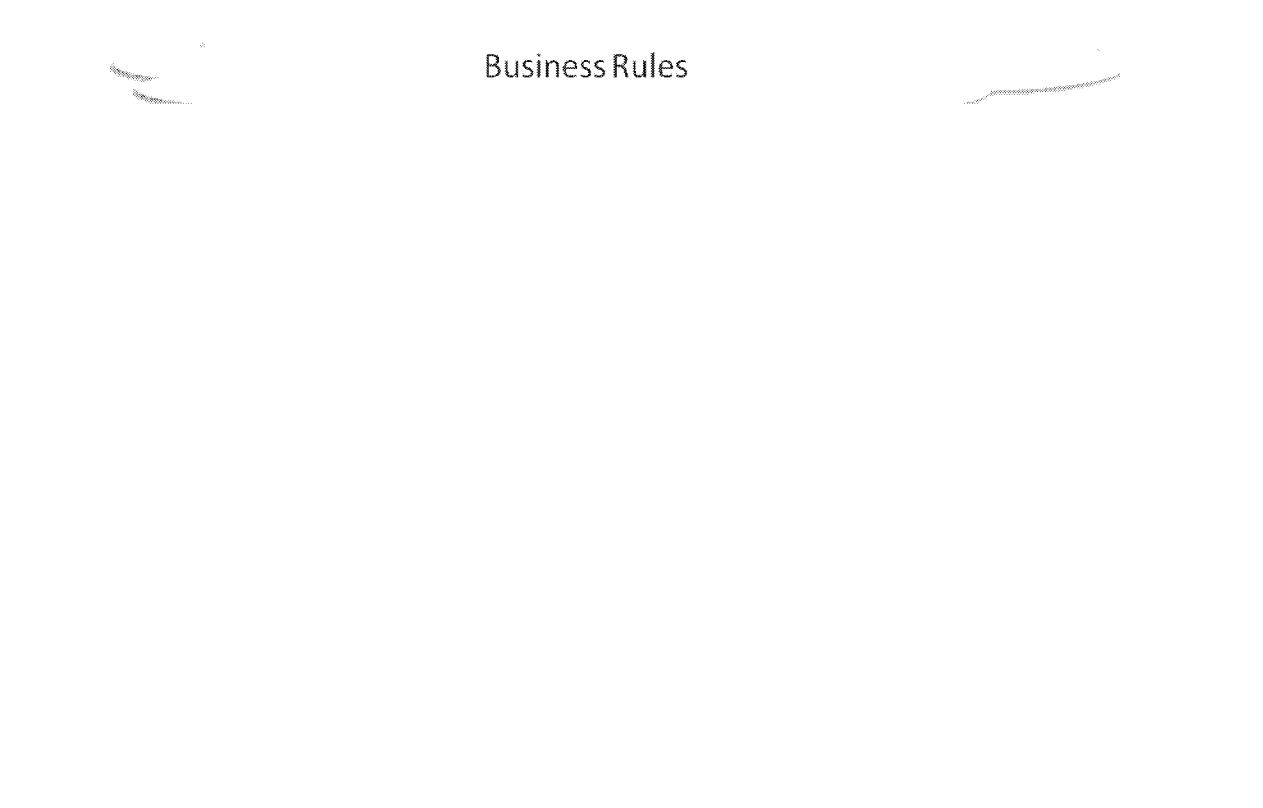
4.2 Electronic Travel Authorization (eTA)

Other divisions, such as OMC (PID, PRPD, TRPD), CPR, SPP-Admissibility, IR, and SPO, are involved in the process of developing the predictive models for eTA.

The eTA project consists of two phases. **eTA phase-1** is now finalized. We have produced and delivered to SPO business rules they could use at launch, based on proxy data (there is no eTA data for now, as eTA does not exist, so DPAT uses proxy data to build models). **eTA phase-2** will be starting in October 2015[5], a few months after the implementation of the eTA (6 to 9 months, depending on if eTA starts with a voluntary period, as this will reduce the number of cases and will have an impact on the population most likely), in order to collect real data set that will be fully representative of the "real" eTA population.

At this point, the implementation date is targeted for the spring of 2016.

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[5] Or even later, given the CR recently submitted to postpone eTA.

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4.3   IN Project

4.3.1   Visitor Record-Extension

This work is to be used to run the pilot for IN Project for TR Pilot (IEC, VR-Extension and Study permit).

Delivered to SPO and Ops:

* Predictive Analytics Models for three scenarios, based on the availability of historical data, and;
*

4.3.2   International Experience Class (IEC)

This project is now closed, as a draft model was delivered to business. As usual, other divisions such as OMC (PID, TRPD), CPR (OSC) and SPO, were involved in the process of developing the predictive models for IEC.

Delivered to SPO and Ops:

*

* An auto-triage model was developed. GCMS Answers replicates the model for OSC, and they will start using this in production for the first batch of applications for this year.

*

A second phase of IEC will be starting in June 2015 in order to improve the model and identify the best model for IEC by incorporating historical data.

4.3.3   Students

Work on this part of the TR Pilot for IN project is close to completion. A draft model is under development and is due to be delivered to the clients, in July 2015.

4.3.4   TRV and TFW

Development of predictive models for TRV and TFW will start in May and July 2015, respectively.

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Figure 3 - Example of TR Triage and Auto-approval
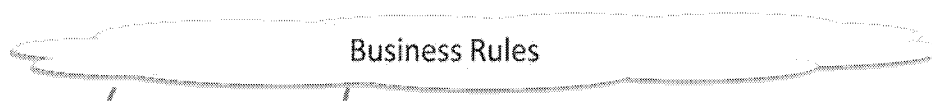
Business Rules

5.0   Engagement and working with SIMB / IT:

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This will also be used to complement risk
and business rules.

Requirements for Predictive Analytics processing in GCMS and in EDW have been developed by DPAT
and are under review. **Functionality for changing business rules (the models) needs to be independent
of GCMS releases and needs to be centrally modified by the program in order to control program risk
or in order to manage workload.** Just-in-time quality assurance will also be made available. Recently,
INP's IEC has highlighted the need for this functionality since Canada has numerous MOUs by country
which control the IEC program; furthermore, they are often influenced by politicians (uninfluenced by
GCMS releases).

**OPMB has recently acquired the free crowd built software "R"[6]. This is the future of math and stats
computing;** R has roughly 100 million users worldwide. It can perform almost any mathematical or
statistical function, including workload optimization. OPMB uses "R" to also replicate the SPSS Modeler
models, for quality assurance purposes.

6.0   Engagement of other departments and other countries:
Predictive analytics is a fast moving technology, and maintaining external partnerships is important to
ensure that business objectives are met and that technology focused activities are aligned with the
broader CIC modernization vision. **With this in mind, OPMB initiated and chairs the Analytics Coalition;**

---

[6] R package is used by Australia.

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a collaborative effort with 13 other government departments and the Privy Council's Central Innovation Hub.

The PCO Innovation Hub heard of OPMB's work on Predictive Analytics, and in November 2014 submitted a representative for our Analytics Coalition. The **PCO will do a presentation at the next Analytics Coalition on an idea for "soft" peer reviewing Predictive Analytics work in the GOC.** The Industry Canada Predictive Analytics team, which has led a recent multi-departmental DM meeting (including our DM) on Big Data, is also a member the Analytics Coalition. OPMB and EDW has also helped them to prepare for a multi-departmental CIO meeting on technical issues surrounding Big Data and Predictive Analytics.

Finally, the DPAT has had dedicated meetings with   to leverage what each organization does. The DPAT has also engaged in conversations with the UK (by CBSA LIO) and the Australian governments (directly), and visited the US last year. The DPAT also participates in government-centric Predictive Analytics conferences.

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Annex 1: Opportunities for Success

Decision making processes at CIC can be enhanced by using predictive analytics models, which offer the following benefits:

-

- Increases operational efficiency by reducing the number of paper based, manual business processes.

-

- Decreases the effort required to do quality assurance.

-

- Enables triaging and organizing application workload for optimal throughput.
- Can be used as legal evidence to support CIC.

Business user satisfaction and an improved client experience are also key success factors. Long term success will be evidenced by a pervasive culture of analytical thinking at CIC, mathematically sound practices, and the capacity to participate with other government departments on predictive analytics projects. Key aspects of successful projects as it relates to Data and Predictive Analytics:

1. Simplify the concept of predictive analytics for business users and managers.
2. A consistent process for collaborating with the business stakeholders
3. Specific business outcomes for predictive analytics work
4. Adequate IT support
5. Proper communication of the results of predictive modeling to business stakeholders
6. Having timely insights from predictive models in front of the business staff that can best use them
7. A closed-loop feedback process for improving and updating predictive models.
8. Executive endorsement of the results and for data driven decision making

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Annex 2: Seven Steps for Predictive Analytics Projects

1. Collect Data and Business Requirements

2. Conduct preliminary Data Analysis*

3. Develop Predictive Models*

4. Validate Predicative Models*

5. Conduct Statistical modeling of risk/complexity scoring

6. Implement Predictive Models

7. Monitor and Maintain Models

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Annex 3: DPAT Project Overview

- Completed

Last Updated: 04/28/2015
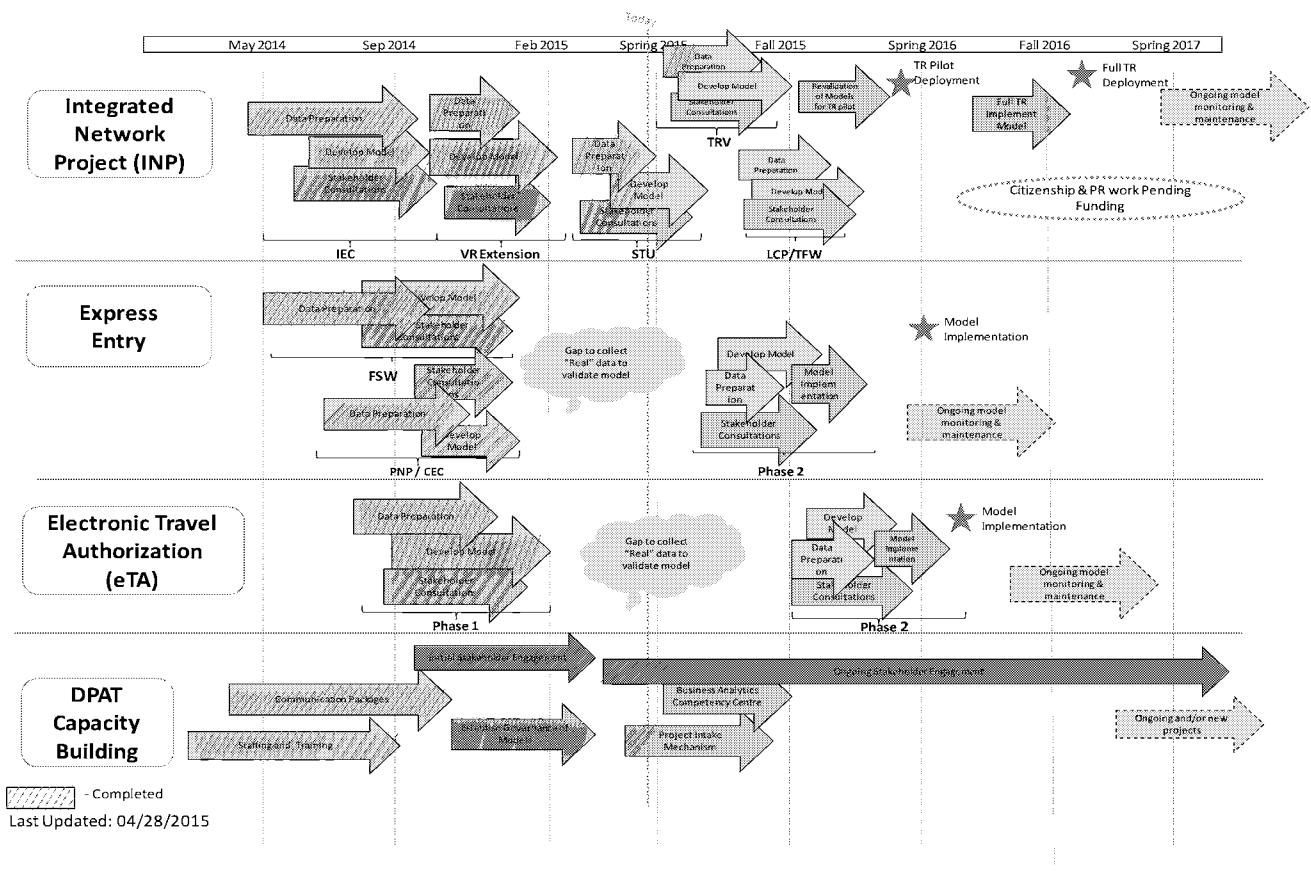
Done by DPAT, for Updating Senior Management, as year-end report, P. 12

A-2018-09320-000534

Citizenship and   Citoyenneté et
Immigration Canada   Immigration Canada

Citizenship and Immigration Canada

Using Predictive Analytics to Reduce Processing Times
December 22, 2015

Canada

Overview of the presentation; can be read line-by-line or simply communicated.

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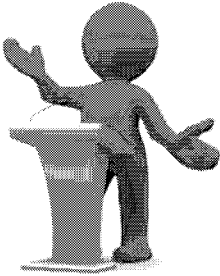
IRCC's Challenge with Processing Times

- IRCC's current processing capacity is not sufficient to address demand in a timely manner.

- Pressures will intensify as the volume of applications grows.
  - TR volumes could rise by 36% between 2015-16 and 2021-22.

- Keeping pace with rising volumes isn't enough; the Prime Minister has asked IRCC to reduce processing times.

Projections of Temporary Resident Applications (Unofficial)

Canada

Unofficial forecasts

What is Predictive Analytics?

Predictive analytics consists of using computer technology to analyze past behaviours; through this analysis, we can discover patterns that enable predictions of future events.

Predictive analytics is the result of a combination of...

- Statistics
- Computer Sciences
- Operational Expertise
- Specialized Software
- Business Analysis

The benefits of predictive analytics are...

- Supports evidence-based decision making by exploiting vast amounts of data;
- Substantiates decisions made by intuition or gut feeling;
- Enables faster business processes;
- Increases consistency in decision making;
- Helps maximize the use of resources;
- Generates synergies between business expertise and statistical analysis.

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Our data scientists are highly skilled (Master's or PhD's) on how to rigorously apply statistical techniques.

Senior management and the lines of business would have to define what constitutes an acceptable margin of error.

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s.16(2)

Under the Hood

- For each line of business, our data scientists choose the type of model that yields the highest accuracy.

- So far, decision trees using the C5.0 algorithm have always been the most accurate.

- Such models generate clear decision-making rules, for example:
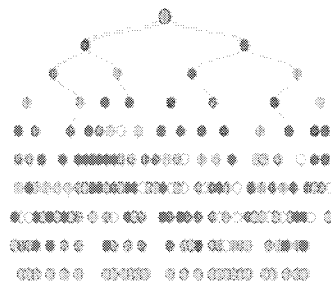
- The rules can be very granular with many conditions, reflecting the nuances of real-life decisions.

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Additional Benefits of Predictive Analytics

- The criteria in these rules can also be used to identify risk indicators to support program integrity.

    - We are already working with one line of business to identify characteristics of high-risk individuals.

-

- Future uses of predictive analytics:

    - Improve workload distribution by automatically assigning cases to the appropriate level of officer.

- **These benefits are closely tied to the vision of the Integrated Network Project, in which predictive analytics plays a key role.**

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s.16(1)(b)

s.16(2)

Includes TR and PR lines of business.

Assumes no improvement in forecasting accuracy of models over time, which is pessimistic.

Challenges Faced by Predictive Analytics at CIC
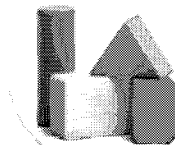
IT Architecture for Predictive Analytics

• Need to build the IT systems that will allow real-time information flows between the predictive models and GCMS.

• Additional funding is required, otherwise predictive analytics cannot be deployed to help reduce processing times.
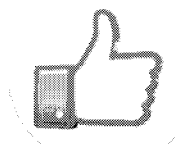
Creating Support at the Program Delivery Level
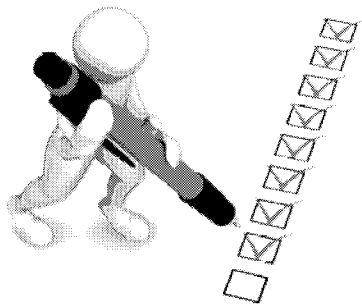
• Officers must be ready to smoothly transition to analytics-driven business environment.

• A change management strategy is being developed.

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s.16(1)(b)

s.16(2)

The Next Steps

- Work with SIMB to define IT requirements;
- Test existing models in real time, once IT systems are implemented;
- Develop new models for other lines of business;
-

- Develop models for workload management;
- Continue stakeholder engagement and outreach;
- Support IN Project's change management strategy.

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Some notes on number of cases needed for testing or revision of the model for Express Entry once actual data is available

For Express Entry, DPAT should be able to conduct the first testing and if necessary revision of the model when actual FinDec will be available for at least 3,000 applications. This was estimated by conducting several trials on randomly taken sample of 2% (2,936) of FSW data set (the most challenging to model) and the results were proven to be reasonable and valid. The monitoring of Express Entry admissions on weekly basis is necessary to establish the time period for required actual data be available.

As for March 15, 2015, CIC has received 737 applications from invited candidates (about 21.5% of invitations).

Taking into the consideration this recent trend in finalizing applications, DPAT believes that testing and revision of the model will have to wait several months; with possibility to wait to the end of 2015.

Trials:

The following is the presentation of results for FSW model for 2% of data that is 2,936 applications.

There were five trials conducted to see if the model still results in accurate prediction for five randomly selected 2% samples of data set.

Trial 1

Trial 2

s.16(1)(b)

s.16(2)

Trial 3

Trial 4

s.16(1)(b)

s.16(2)

Trial 5

Trial's Results

The accuracy of the model varied insignificant from 86% to 89% for five randomly selected data samples. This indicates the robustness of the model for 2% sample of the data.

Next steps:
1- Integrate new information (from current holdings) to increase accuracy. The new model will be built using more fields and historical information. This will increase accuracy of the model as it was observed from the work done for other LoBs.
2- Re-evaluate number of applications finalized by end of June 2015 in order to plan the work and evaluate what will be possible this calendar year.

What could be emphasized and relevant to DPAT from PR e-apps and Express Entry Training Summary

- GCMS will become the only tool to monitor and manage the work performed on FSW, PNP and CEC applications.

- Application processing will become multitasking with simultaneous actions and not really geographically based.

- Files will become tracked and monitored through 'state' rather than through paper file location.

- For our 'bins", it would be beneficial to assign cases with the knowledge of this "state".

- It said that GCMS dashboards cannot monitor the complexity of files or the complexity of the work done and regular communication between supervisors with business knowledge and employees is required. DPAT might participate in these communications regarding the complexity of "cases" since the Integrated Network Project when we have to deal with workload distribution based on complexity.

- EE eligibility will not have any details as why eligible or not eligible besides Status options - Obsolete, Received, or Rejected and cannot be useful for DPAT (page 25).

- For FSW, any principal applicant who identifies their primary occupation as "Pharmacist" will be able to apply only under the Arranged Employment or Ph.D. stream since NOC 3131for pharmacist is not on the current list of eligible occupations.

Meeting on PC   Date Jan 8, 2018

Implementat. By July or sooner if we're ready

Would have to convert ~~application~~ to persons
    ↳ include dependents

Should we use 2017? DART will check to
see if it's okay

For TRV exempt, IN suggests 10% QA sent back to
missions for validat. (QA on OB570 is currently
zero)
What would 10% of overall represent? Not just 10% of
the incremental volume?
    - Gross now
    - Net increase
    - 10% of new total

Maybe sample for entire group: India/Phil +
                                    TRV exempt

FC meeting
Date Aug 3, 2017

CN/IN/ ~~China~~ New triage criteria for visa-exempt : higher volume but ⟶simple   still higher app. rate.
IPG

Consultations w missions showed support

Memo to ADM

CN to decide when it will be implemented

Pilot : New Delhi — Manila

Isabelle thinks that ND may have ↑ amount of scrutiny, thus resulting in more interviews.

Can we find commonalities among the 3% of Manila interviews?

(*) Share some stats on Pilot

⟹ Isabelle: perhaps wait for report on pilot from Manila and ND to see what they found and whether they can identify criteria for narrowing to lower risk

ND may prefer centralizing PNP. We'll see.

Page

C5 and Apriori

Rank Apriori Prediction

Apriori performs
better

Rank - C5 prediction
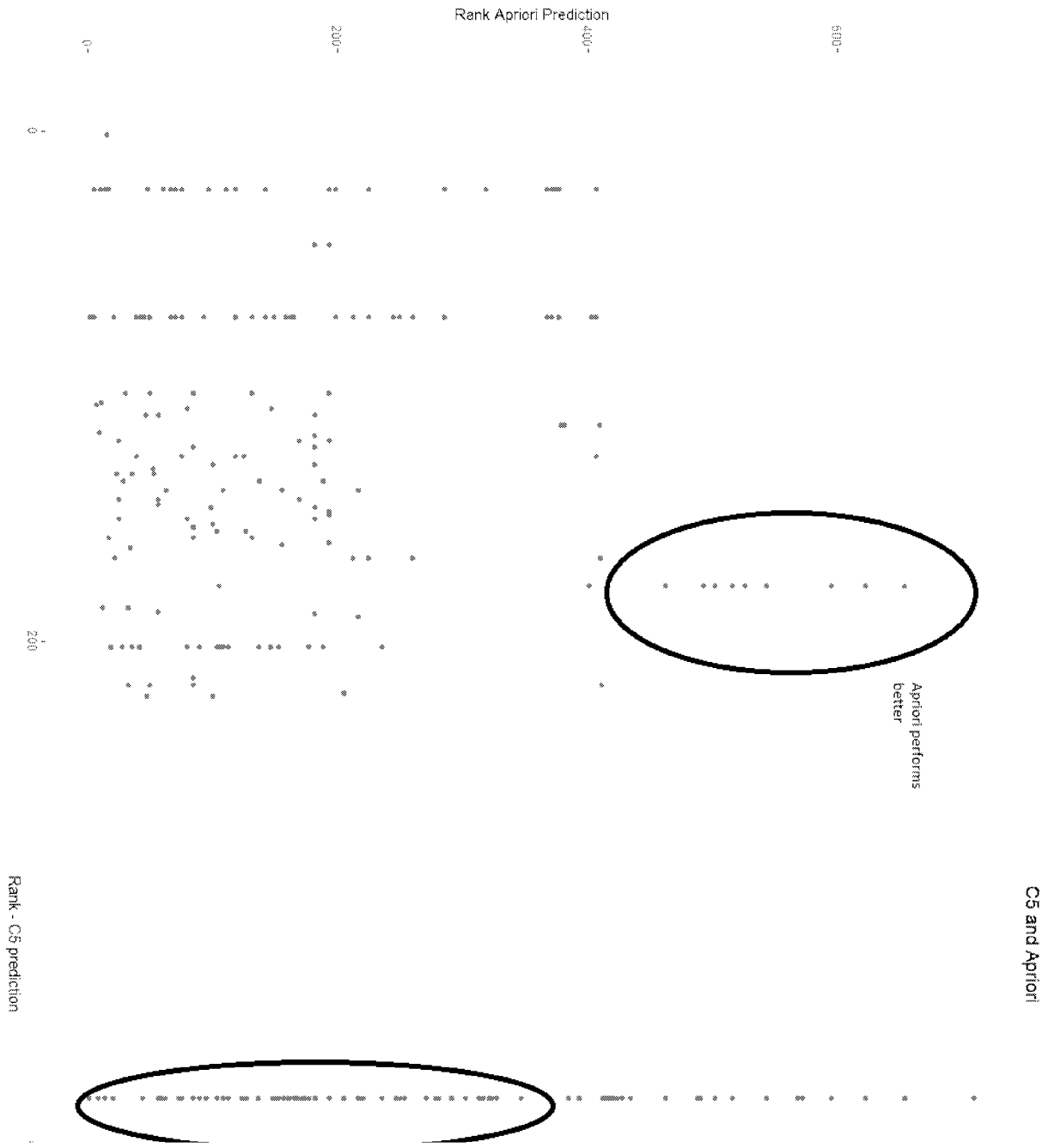
Techniques Explored for Modelling Rare Data

General Notes:

1) Almost all of our business problems are binary classification problems. We may occasionally look at unsupervised approaches, but we generally don't do regression.
2) Almost all of our data is discrete/categorical. Many of the fields we use are binary.
3) Most business problems have significant class imbalance (roughly 0.1% to 15% of the data in the minority class).

1) C5.0 Decision Trees:
   a. Provides generally good results compared to other methods we've explored.
   b. Provides interpretability of the final ruleset, which is valuable from an operational perspective.
   c. Relatively well-suited to imbalanced data when used with a mixture of cost-weighting and pre-balancing of the data (over/under sampling).
   d. Cost-weighting reduces interpretability of rules.

2) Other Decision Trees:
   a. Some exploration of other decision tree methods (rpart, CHAID, etc.). Test results have generally been inferior to C5.0.

3) Classification based on Association Rules (apriori):
   a. Built in R.
   b. Well-suited for imbalanced data as it doesn't requiring oversampling or undersampling of minority/majority classes. Simple to interpret and explain to others.
   c. Computationally expensive and high possibility of overfitting given the large complement of rules being generated. Rule space explodes exponentially in the number of features examined. Requires discretization of continuous features. Less developed in the literature.

4) Decision Lists (SPSS Modeler):
   a. Modeler-specific algorithm functionally very similar to the association rule technique mentioned above.
   b. High Interpretability.

5) Random Forest
   a. Some dabbling with random forest. Has similar balancing challenges as other decision tree methods and is harder to interpret/explain to non-technical people. Computationally expensive.

6) Logistic Regression:
   a. We've experimented with this in the past, though no work recently.

7) Other:
   a. We've done relatively minimal exploration of a variety of other modeling techniques. We have not investigated these in depth and they may represent additional opportunities.

8) SMOTE (data balancing):
   a. We've explored this method for balancing data using synthetic oversampling. The results have been mixed or slightly positive improvements to the models.
   b. Most of our data is categorical, which may not lend itself well to this technique.

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Data and Predictive Analytics: Initial projects & ongoing

Timeline axis: Spring 2014 · Fall 2014 · Spring 2015 · Fall 2015 · Spring 2016 · Fall 2016 · Spring 2017

Integrated Network Project (INP)
- Data Preparation
- Develop Model
- Stakeholder Consultations
- IEC
- VR Extension
- Data Preparation / Develop Model / Stakeholder Consultations — TRV
- STU
- Data Preparation / Develop Model / Stakeholder Consultations
- LCP/TFW
- Implement TR Pilot Model
- ★ TR Pilot Deployment
- Full TR Model Implementation
- ★ Full TR Deployment
- Ongoing model monitoring & maintenance
- Citizenship & PR work Pending Funding

Express Entry
- Data Preparation
- Develop Model
- Stakeholder Consultations
- FSW
- Data Preparation
- Develop Model
- Stakeholder Consultations
- PNP / CEC
- Gap to collect "Real" data to validate model
- Develop Model
- Data Preparation
- Model Implementation
- Stakeholder Consultations
- ★ Model Implementation
- Phase 2
- Ongoing model monitoring & maintenance

Electronic Travel Authorization (eTA)
- Data Preparation
- Develop Model
- Stakeholder Consultations
- Phase 1
- Gap to collect "Real" data to validate model
- Develop Model
- Data Preparation
- Model Implementation
- Stakeholder Consultations
- ★ Model Implementation
- Phase 2
- Ongoing model monitoring & maintenance

DPAT Capacity Building
- Initial Stakeholder Engagement
- Ongoing Stakeholder Engagement and Change Management
- Communication Packages
- Establish Governance of Models
- Staffing and Training
- Business Analytics Competency Centre
- Project Intake Mechanism
- Ongoing model monitoring and/or new projects

Legend:
⧄ - Completed

Last Updated: 02/10/2016

Today

A-2018-09320-000556

Data and Predictive Analytics: Initial projects & ongoing

Today

| May 2014 | Sep 2014 | Feb 2015 | Spring 2015 | Fall 2015 | Spring 2016 | Fall 2016 | Spring 2017 |

Integrated Network Project (INP)

- Data Preparation
- Develop Model
- Stakeholder Consultations
- Data Preparation
- Develop Model
- Stakeholder Consultations
- Data Preparation
- Develop Model
- Stakeholder Consultations

IEC

VR Extension

- Data Preparation
- Develop Model
- Stakeholder Consultations

STU

TRV

- Revalidation of Models for TR pilot

TR Pilot Deployment

- Data Preparation
- Develop Mod
- Stakeholder Consultations

LCP/TFW

- Full TR Implement Model

Full TR Deployment

Ongoing model monitoring & maintenance

Citizenship & PR work Pending Funding

Express Entry

- Data Preparation
- Develop Model
- Stakeholder Consultations

FSW

- Stakeholder Consultations
- Data Preparation
- Develop Model

PNP / CEC

Gap to collect "Real" data to validate model

- Develop Model
- Data Preparation
- Model Implementation
- Stakeholder Consultations

Phase 2

Model Implementation

Ongoing model monitoring & maintenance

Electronic Travel Authorization (eTA)

- Data Preparation
- Develop Model
- Stakeholder Consultations

Phase 1

Gap to collect "Real" data to validate model

- Develop Model
- Data Preparation
- Model Implementation
- Stakeholder Consultations

Phase 2

Model Implementation

Ongoing model monitoring & maintenance

DPAT Capacity Building

- Communication Packages
- Staffing and Training
- Initial Stakeholder Engagement
- Establish Governance of Models
- Business Analytics Competency Centre
- Project Intake Mechanism
- Ongoing Stakeholder Engagement

Ongoing and/or new projects

///// - Completed

Last Updated: 07/07/2015

Data and Predictive Analytics: Initial projects & ongoing

Timeline: May 2014 | Sep 2014 | Feb 2015 | Today Spring 2015 | Fall 2015 | Spring 2016 | Fall 2016 | Spring 2017

Integrated Network Project (INP)

Data Preparation
Develop Model
Stakeholder Consultations

Data Preparation
Develop Model
Stakeholder Consultations
IEC

Data Preparation
Develop Model
Stakeholder Consultations
VR Extension

Data Preparation
Develop Model
Stakeholder Consultations
STU

Data Preparation
Develop Model
Stakeholder Consultations
TRV

Data Preparation
Develop Model
Stakeholder Consultations
LCP/TFW

Implement TR pilot Model
TR Pilot Deployment

Full TR Implement Model
Full TR Deployment

Ongoing model monitoring & maintenance

Citizenship & PR work Pending Funding

Express Entry

Data Preparation
Develop Model
Stakeholder Consultations
FSW

Data Preparation
Develop Model
Stakeholder Consultations
PNP / CEC

Gap to collect "Real" data to validate model

Develop Model
Data Preparation
Stakeholder Consultations
Model Implementation
Phase 2

Model Implementation

Ongoing model monitoring & maintenance

Electronic Travel Authorization (eTA)

Data Preparation
Develop Model
Stakeholder Consultations
Phase 1

Gap to collect "Real" data to validate model

Develop Model
Data Preparation
Stakeholder Consultations
Model Implementation
Phase 2

Model Implementation

Ongoing model monitoring & maintenance

DPAT Capacity Building

Communication Packages
Staffing and Training

Initial Stakeholder Engagement
Establish Governance of Models

Ongoing Stakeholder Engagement

Business Analytics Competency Centre
Project Intake Mechanism

Ongoing and/or new projects

////// - Completed

Last Updated: 03/19/2015

A-2018-09320-000558

Data and Predictive Analytics: Initial projects & ongoing

Today

| May 2014 | Sep 2014 | Feb 2015 | Spring 2015 | Fall 2015 | Spring 2016 | Fall 2016 | Spring 2017 |

Integrated Network Project (INP)

Data Preparation

Data Preparation

Develop Model

Develop Model

Stakeholder Consultations

Stakeholder Consultations

Data Preparation

Develop Model

Stakeholder Consultations

IEC

VR Extension

STU

Data Preparation

Develop Model

Stakeholder Consultations

TRV

Revalidation of Models for TR pilot

TR Pilot Deployment

Data Preparation

Develop Model

Stakeholder Consultations

LCP/TFW

Full TR Implement Model

Full TR Deployment

Ongoing model monitoring & maintenance

Citizenship & PR work Pending Funding

Express Entry

Data Preparation

Develop Model

Stakeholder Consultations

FSW

Stakeholder Consultations

Data Preparation

Develop Model

PNP / CEC

Gap to collect "Real" data to validate model

Develop Model

Data Preparation

Model Implementation

Stakeholder Consultations

Phase 2

Model Implementation

Ongoing model monitoring & maintenance

Electronic Travel Authorization (eTA)

Data Preparation

Develop Model

Stakeholder Consultations

Phase 1

Gap to collect "Real" data to validate model

Develop Model

Data Preparation

Model Implementation

Stakeholder Consultations

Phase 2

Model Implementation

Ongoing model monitoring & maintenance

DPAT Capacity Building

Initial Stakeholder Engagement

Ongoing Stakeholder Engagement

Communication Packages

Staffing and Training

Establish Governance of Models

Business Analytics Competency Centre

Project Intake Mechanism

Ongoing and/or new projects

////// - Completed

Last Updated: 04/28/2015

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RPXXX Predictive Analytics in Processing Applications

▲Version Date		Details
V1.0	02/19/15	BPM first draft
V2.0	03/23/15	
V3.0	03/27/15	
V4.0	04/7/2015	Incorporated MJ comments, ready for consultation
V5.0	04/15/2015	Incorporated comments from MJ and the business
V6.0	04/20/2015	Incorporated comments from MJ and the business (SPO and OMC)
V7.0	04/21/2015	Consulted with SPO and EDW

Notes on current version:
1. The steps in this BPM do not reflect all user control rules.

Recurring **Sub-Processes** referenced by this model
RP001 Search
RP003 Create

TR/PR Triage and Auto-approval (all Business Lines – Including eTA)

GCMS

Application goes through process as soon received

1.0.0
Create Application and Basic Name search

See GCMS RP003 and others

2.0.0
Client Search for Immigration History

See GCMS RP001

3.0.0
Create Output for Predictive Analytics Models

9.0.0
Apply Rules to Dispatch cases

10.0.0
Categorize Applications

11.0.0
Send for Processing

12.0.0

13.0.0
Auto- No

14.0.0*
Auto-YES (XX%)

15.0.0

15.0.0*
Triage for Manual Processing

16.1.0

16.2.0
High Probability of Approval

16.3.0
High Probability of Refusal

16.4.0
Final Decision Probability is Uncertain

16.5.0

16.6.0
Workload Distribution

To be on before deployment. Off after.

17.0.0
Silent Mode

18.0.0
Finalize Application

See GCMS RP80

Exchange Layer

Solution TBD

Predictive Analytics Model and Server

4.0.0
Receive Inputs from GCMS

5.0.0
Prepare and Validate Data

6.0.0
Create Flags and Derived Values

7.0.0
Generate Probability Scores and Bins

8.0.0
Send Inputs to GCMS (Scores and Bins)

Model will create scores to be sent to GCMS

*If boxes 13.0.0 and 14.0.0 is removed, this becomes a Express Entry BPM for PR Triage
** All the shaded boxes will be documented by SPO. DPAT will provide scores by model only.

A-2018-09320-000561

Hybrid Risk Assessment

Business Rules — Mitigation of known risk factors, based on historical and emerging intelligence

Predictive Analytics — Data-driven machine intelligence for risk triage and risk factor identification

Anomaly Detection — Automatic triggers for suspicious data patterns

Fraud/ Gaming Detection — Identifying fraud and gaming behaviour (e.g. multiple conflicting applications); Connecting points to broader networks of organized fraud

OPPORTUNITY ASSESSMENT: eTA

ADVANCED ANALYTICS LAB, IRCC
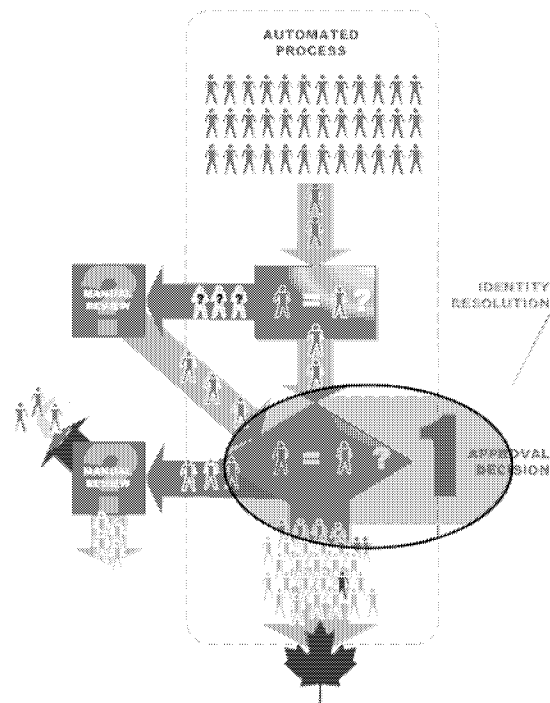
1 SMART DROPOUT

IRCC's automated eTA approval process identifies individuals for manual review. By leveraging enforcement data on previous applicants, we can build a smarter system that automatically adjusts to changing risk trends. This can reduce the number of high-risk travellers that are allowed to fly to Canada.

ESTIMATED COST/BENEFIT

Safety & Security:	■■■■■■■
Financial Savings:*	■■■■
Time Savings:	■■■
Improved Client Service:	■■

TECHNOLOGICAL UNCERTAINTY
LOW

DEPLOYMENT COST
MEDIUM/HIGH

DEPLOYMENT RISK
MEDIUM

* Financial Savings are for Canada as a whole, predicated on reduced enforcement costs borne by CBSA. Direct costs to IRCC would be expected to rise slightly for additional manual dropout review.

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Pages 564 to / à 1008

are withheld pursuant to sections

sont retenues en vertu des articles

16(2), 16(1)(b)

of the Access to Information Act

de la Loi sur l'accès à l'information

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Citizenship and Immigration Canada

Predictive Analytics: presentation to IR Management

May 2015
Prepared by OPMB-PMU-DPAT

Canada
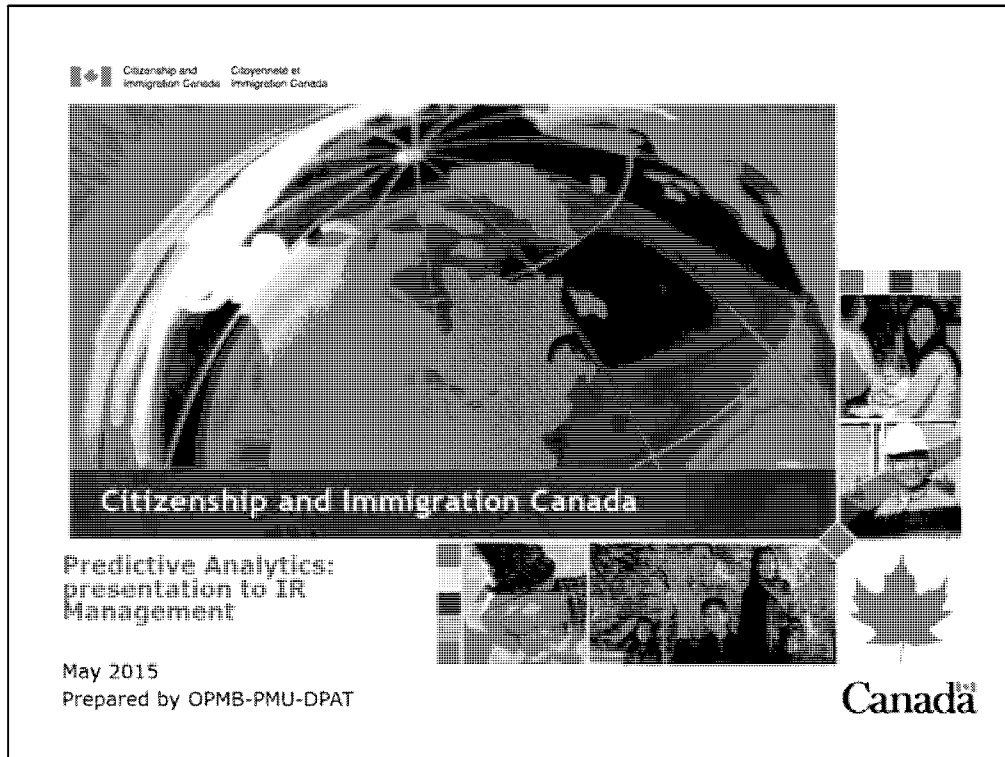
Predictive analytics have **proven value** in private industry and government

Predictive Analytics are **a key piece of the modernization strategy**
DPAT is working closely with partners: SPO, PID, CPR, IR and OMC

CIC is at the very beginning of using predictive analytics
We are catching up on other countries (USA and Australia for example) and other
departments (for ex.)

Expectations need to be set carefully
Predictive analytics can be transformative for an organization,
but it takes a long time to put everything in place

Predictive Analytics – Overview

What is predictive analytics

Predictive analytics at CIC

Why is Predictive analytics important for CIC

Why Predictive Analytics in Operations

Engagement of Key Stakeholders

Projects update

Example-Predictive Analytics Draft Model for VR-extension

DPAT - Next steps

Annex1: Predictive Analytics Approach and Method

Annex2: Data and Predictive Analytics Roadmap

Annex3: Key steps for Success

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s.16(2)

What is Predictive Analytics?

- Predictive analytics is the process of discovering patterns in historical data and behaviours to infer the likelihood of future events and to predict probable outcomes

Drawing on a combination of...
- Computer Sciences
- Statistics
- Operational expertise
- Specialized Software

Benefits
- Formally substantiates business decisions made by intuition or gut feeling
- Combine operational business knowledge and expertise with statistical analysis
-
- Helps maximizing the use of resources
- Drives smarter decision making by extracting insights from the vast quantity of data available in government agencies.

Citizenship and Immigration Canada   Citoyenneté et Immigration Canada

Canada   3

Explains definition and how it works. Also talk about concrete benefits in any business doing predictive analytics (Walmart, for example, or Google, that both use that now in their business to save money, profile their consumers and improve resource allocations)

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:
*
* Increasing processing capacity

* Facilitate program integrity exercises
* Deliver optimal client service

Forecasting vs Predictive analytics:

1. **Enable CIC's modernization agenda:**

   -

     Integrated Network Project, eTA, Express Entry, and more...;

   -

   - By reducing the labor intensity of application triaging and processing as well as minimize the time to a decision for a significant number of cases.

   -

2. **Help to detect and reduce fraud and contribute to program integrity**

Predictive Analytics at CIC have two important goals:

1.

2.

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Why is predictive analytics important for CIC?

➤

➤   ￼

Predictive analytics at CIC will:

1. Enable CIC's modernization agenda
2. Help to detect and reduce fraud and contribute to program integrity
3. Help CIC to cope with increased volume of applications
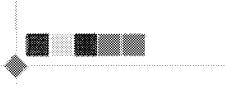
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5

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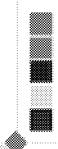
s.16(1)(b)

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Predictive Analytics in Operations

1. **Lead: OPMB- PMU**
   - Established expertise and experience in Business Intelligence (BI) providing deep, sophisticated analytics on large volumes of actual and historical data.
   - Network wide experience in workload distribution in collaboration with the network and sector.
   - Situated as impartial and objective enabler of operational resource allocation;
   -
   - OPMB is the lead for Data Governance in the department, in partnership with R&E.

2. **Key partners and clients:**
   - OMC : Program expertise (TRPD, PRPD) and program integrity (PID)
   - SPO : Project leads and clients
   - CPR (including regions when needed) and IR: Experts in processing and subject matter experts for intelligence gathering
   - SIMB: support IT systems and data
   - Other departments and jurisdictions: for lessons learned, best practices and information sharing.

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> **Our stakeholder engagement* is three folded:**
> **1.Bi-weekly working group meetings with partners**
> – Every DPAT project (models) starts with a clear definition of business goals and a partnership is formed with the line of business
> –DPAT Discuss findings with the business on regular basis for validation and to combine qualitative business knowledge with empirical statistical research
> **2. Stakeholder engagement sessions**
> –bi-monthly stakeholder engagement sessions to discuss findings with the business on regular basis for validation and to combine qualitative business knowledge with empirical statistical research
> –Program experts, policy and administrative teams need to be involved to ensure successful project delivery
> **3. Engagement and sharing best practices with other departments and other countries;**
> –Held numerous meeting with CBSA
> –Initiated a collaborative effort with other government departments and chairs a Data Analytics Coalition with key government departments and agencies

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Speaker: Marie-Josee

and to allow for groupings to be done for automated distribution of applications.

1- Express Entry:

1- Express Entry-phase 1: COMPLETED
•DPAT developed models for FSW, CEC and PN and delivered Business rules for launch of Express Entry

•DPAT is working with CPR and Ops to use the business rules a level deeper by using GCMS Answers to create dashboards that will allow applications to be grouped and assigned, using the dashboard.

2- Express Entry-phase 2: will start in a few months
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•Express Entry auto-triaging model will be deployed in spring 2016.

2-

2. **eTA phase-2:** will be starting in Oct 2015 (or even later now, with the new date)

- Once we have phase 2 data; i-e real data coming from eTA applications.

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    1.1. ICE

IEC Working Groups held with stakeholders and draft model and GCMS Answers case-statements was delivered to OSC. Currently participating in INP IEC Phase 1 implementation (the digitization of IEC).

DPAT will rebuild the model just prior to launching the Phase 2 pilot in 2016.

1.2. VR-Extension

.

VR-extension project started in Dec 2014 and is finalized in February 2015.
DPAT delivered Predictive Analytics Model to SPO and OPS.
1.3. STUDENT
_DPAT is starting the working groups with stakeholders to develop predictive model for auto-triaging

2.Full TR
TRV and TFW (including LCP)
_DPAT will start the working groups with stakeholders to develop predictive models in Spring 2015

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Projects Update (con't)

3- IN Project

1- TR Pilot: for deployment in June 2016.
- IEC: Draft model COMPLETED
- VR-EXTENSION : Draft model COMPLETED
- STUDENT : started in February 2015
  - Draft model under development.

The models developed during 2014 and 2015 for the TR Pilot will be retested and validated with new applications in the months before launch.

2- Full TR: for deployment in January 2017
- The "full TR" includes :
  - Visitors (TRV), Temporary Foreign Workers (TFW) , including Live-in Caregiver (LCPs).
- TRV and TFW (including LCP): Development of predictive models will start in Summer 2015

3-

1.TR Pilot: for deployment in the Spring/ June 2016.

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EXAMPLE : Predictive Analytics draft model for VR-extension

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DPAT – Next Steps

- **Deliver on Projects**
  - a) IN Project
    - TR Pilot
    - FULL TR
  - b) Express Entry –Phase 2
  - c) eTA –phase 2

- **Monitor and improve models (including QA and QC of performance of models)**

- **Continue Stakeholder engagement and outreach**

- **Consult and agree on model governance**

- **With work IT to develop solutions**

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Annex 2: Data and Predictive Analytics Road Map

Annex 3: Key Steps for Success

Key Steps to Success with Predictive Analytics

- Simplify the concept of predictive analytics for business users and managers.
- Executive sponsorship for predictive analytics projects
- A consistent process for collaborating with the business stakeholders
- Specific business outcomes for predictive analytics work
- Adequate IT support
- Proper communication of the results of predictive modeling to business stakeholders
- Having timely insights from predictive models in front of the business staff that can best use them
- A closed-loop feedback process for improving and updating predictive models.
- Executive endorsement of the results and for data driven decision making
- A center of excellence for data and predictive analytics

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Citizenship and Immigration Canada

Citoyenneté et Immigration Canada

Citizenship and Immigration Canada

Predictive Analytics at CIC

September 2015
Prepared by OPMB-PMU-DPAT

Canada

Predictive analytics have **proven value** in private industry and government

Predictive Analytics are **a key piece of the modernization strategy**
DPAT is working closely with partners: SPO, PID, CPR, IR and OMC

CIC is at the very beginning of using predictive analytics
We are catching up on other countries (USA and Australia for example) and other departments

Expectations need to be set carefully
Predictive analytics can be transformative for an organization,
but it takes a long time to put everything in place

Speaker: Stephanie Kirkland

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et Citoyenneté Canada

What is Predictive Analytics?

► Predictive analytics is the process of discovering patterns in historical data and behaviours to infer the likelihood of future events and to predict probable outcomes

Drawing on a combination of...

- Computer Sciences
- Statistics
- Operational expertise
- Specialized Software

Benefits

- Formally substantiates business decisions made by intuition or gut feeling
- Combine operational business knowledge and expertise with statistical analysis
-
- Helps maximizing the use of resources
- Drives smarter decision making by extracting insights from the vast quantity of data available in government agencies.

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Explains definition and how it works. Also talk about concrete benefits in any business doing predictive analytics (Walmart, for example, or Google, that both use that now in their business to save money, profile their consumers and improve resource allocations)

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:
*
* Increasing processing capacity
*
* Facilitate program integrity exercises
* Deliver optimal client service

Why is predictive analytics important?

- Predictive analytics offers the opportunity to use data to drive decisions

- With the help of Predictive Analytics, decision making process will be:
  - Quantitative
  - Evidence-based
  - Easily verifiable and easier to measure
  - More easily adjusted to meet new challenges and requirements and to respond to emerging risks
  - More consistent across the entire CIC processing network
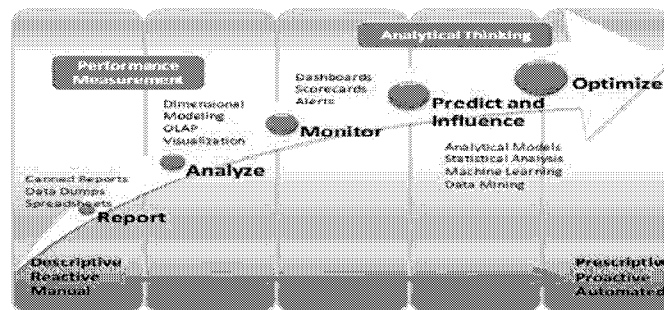
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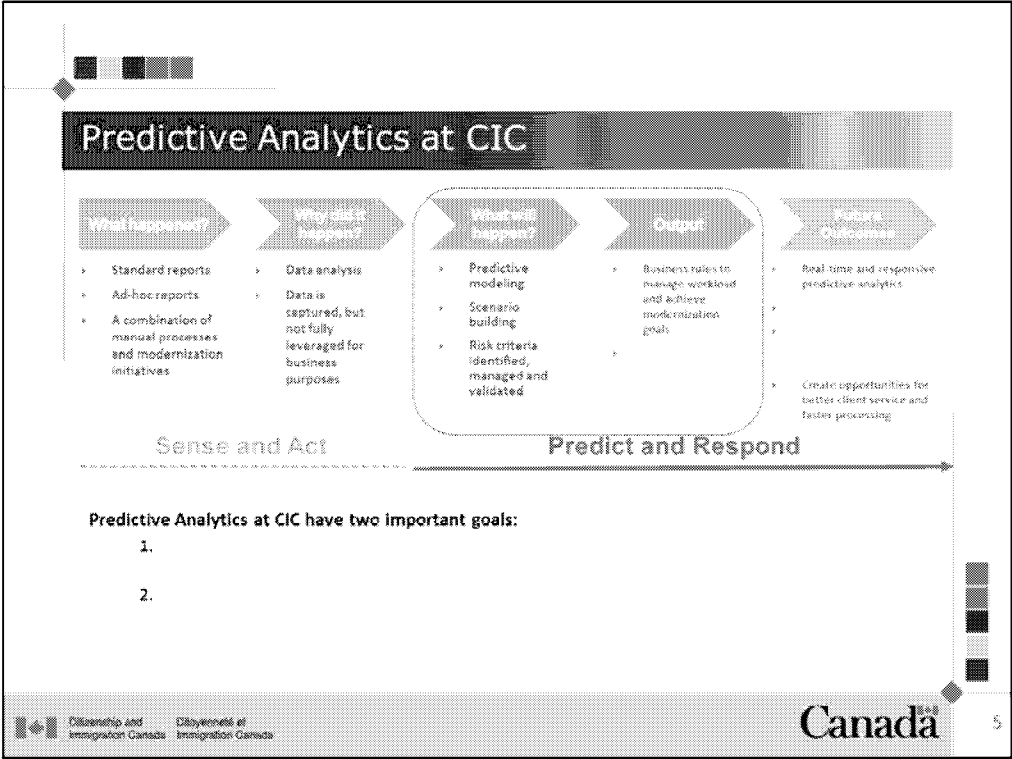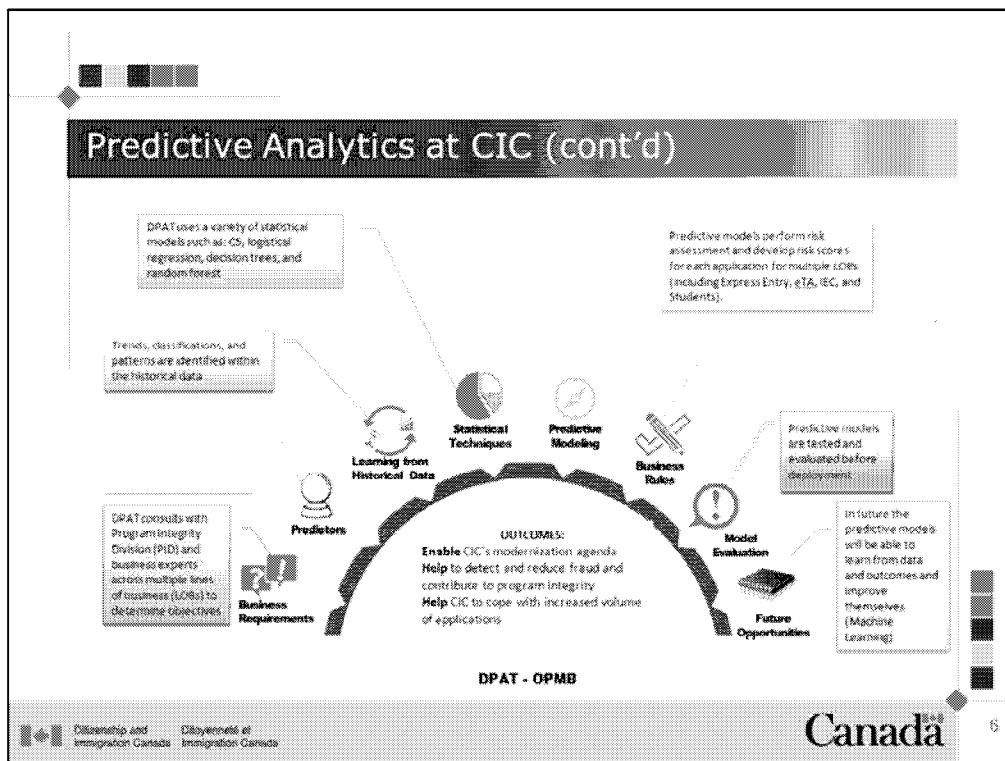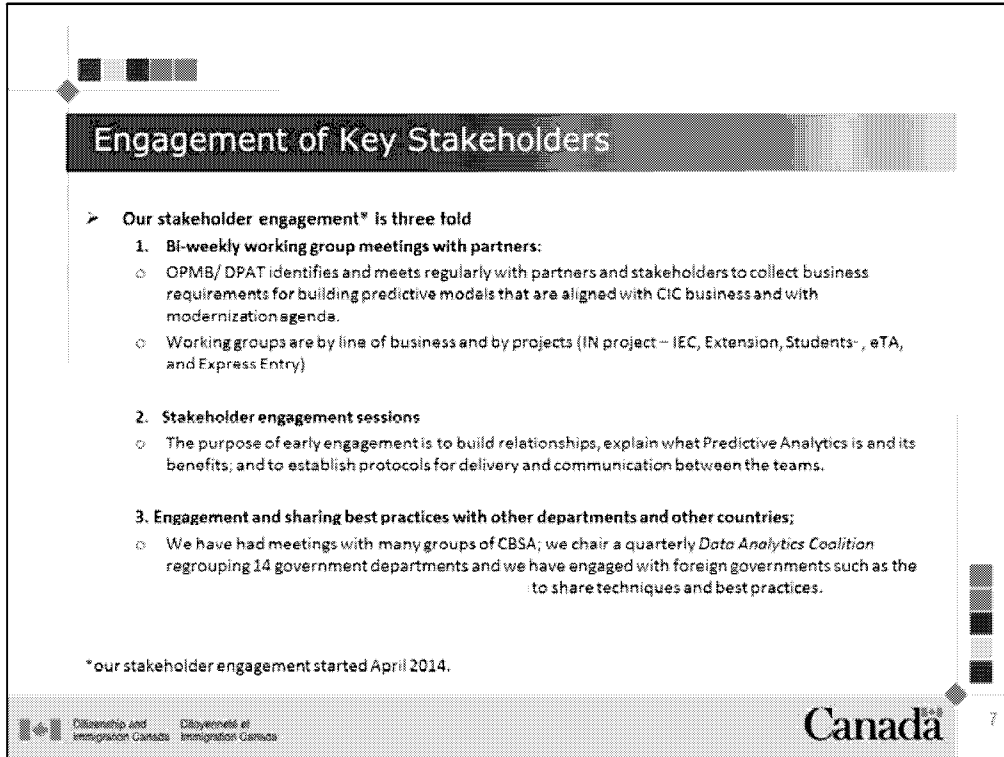
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Engagement of Key Stakeholders

➤ Our stakeholder engagement* is three fold
  1. Bi-weekly working group meetings with partners:
  ○ OPMB/ DPAT identifies and meets regularly with partners and stakeholders to collect business requirements for building predictive models that are aligned with CIC business and with modernization agenda.
  ○ Working groups are by line of business and by projects (IN project – IEC, Extension, Students-, eTA, and Express Entry)

  2. Stakeholder engagement sessions
  ○ The purpose of early engagement is to build relationships, explain what Predictive Analytics is and its benefits; and to establish protocols for delivery and communication between the teams.

  3. Engagement and sharing best practices with other departments and other countries;
  ○ We have had meetings with many groups of CBSA; we chair a quarterly *Data Analytics Coalition* regrouping 14 government departments and we have engaged with foreign governments such as the to share techniques and best practices.

*our stakeholder engagement started April 2014.

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EXAMPLE : Predictive Analytics draft model for WR extension

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Historically, BI leaders have lived in a world where they centrally own and manage the data warehouse, and are responsible for delivering reports to the business. Today there are two distinct worlds, serving different types of users who have different analytical needs. One world provides casual users with reports and dashboards built to answer predefined questions using IT-certified data. The other gives power users unfettered access to any data to answer unanticipated questions using ad-hoc query and analysis tools. (Wayne Eckerson)
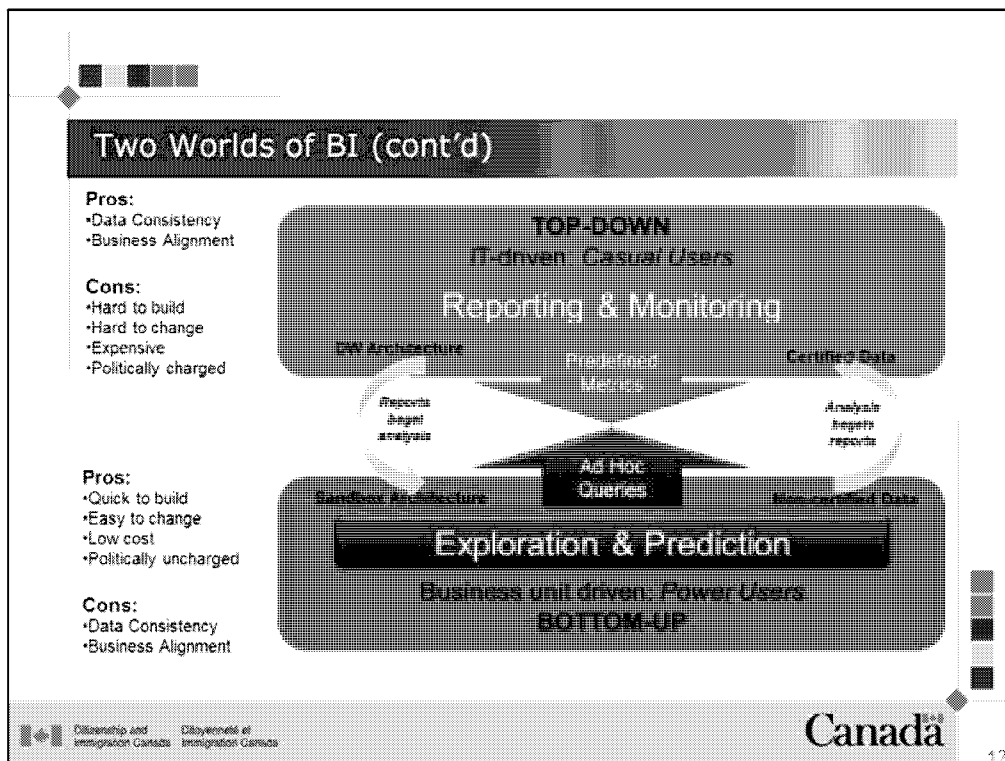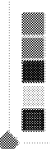
Top down. The "top down BI", is driven by the information technology (IT) to meet the needs of casual users who primarily (but not exclusively) want to monitor known processes using dashboards that contain certified data gleaned from the data warehouse. The downside of top-down BI is that generating certified data takes time, money and political willpower, and it's not optimized to support self-service BI. (Wayne Eckerson)

Bottom up . It is driven by business unit heads to meet the needs of power users who are tasked to find new insights (not monitor existing processes) and answer unanticipated questions using any data, certified or not. It is agile and supports self service to a fault. (Wayne Eckerson)

DPAT – Next Steps

- **Deliver on Projects**
  - a) IN Project
    - TR Pilot
    - FULL TR
  - b) Express Entry –Phase 2
  - c) eTA –phase 2

- **Monitor and improve models (including QA and QC of performance of models)**

- **Continue Stakeholder engagement and outreach**

- **Consult and agree on model governance**

- **Develop IT solutions**

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Speaker: Stephanie

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Speaker : SK or MJ

OF NOTE : THIS IS AN ITIRATIVE PROCESS, where we can go through steps one time, but we can also go between steps and come back if needed.

The Predictive Analytics approach and methods is based on the CRISP-DM phases.

CRISP-DM breaks the process of data mining into six major phases (and we have developed and agreed on a 7 step process)

1- Business Understanding : This initial phase focuses on understanding the project objectives and requirements from a business perspective, and then converting this knowledge into a data mining problem definition, and a preliminary plan designed to achieve the objectives.

2- Data Understanding: The data understanding phase starts with an initial data collection and proceeds with activities in order to get familiar with the data, to identify data quality problems, to discover first insights into the data, or to detect interesting subsets to form hypotheses for hidden information.

3-Data Preparation: The data preparation phase covers all activities to construct the final dataset (data that will be fed into the modeling tool(s)) from the initial raw data. Data preparation tasks are likely to be performed multiple times, and not in any prescribed order. Tasks include table, record, and attribute selection as well as transformation and cleaning of data for modeling tools.

4- Modeling: In this phase, various modeling techniques are selected and applied, and their parameters are calibrated to optimal values. Typically, there are several techniques for the same data mining problem type. Some techniques have specific requirements on the form of data. Therefore, stepping back to the data preparation phase is often needed.

5- Evaluation: At this stage in the project you have built a model (or models) that appears to have high quality, from a data analysis perspective. Before proceeding to final deployment of the model, it is important to more thoroughly evaluate the model, and review the steps executed to construct the model, to be certain it properly achieves the business objectives. A key objective is to determine if there is some important business issue that has not been sufficiently considered. At the end of this phase, a decision on the use of the data mining results should be reached.

6-Deployment: Creation of the model is generally not the end of the project. Even if the purpose of the model is to increase knowledge of the data, the knowledge gained will need to be organized and presented in a way that the customer can use it. Depending on the requirements, the deployment phase can be as simple as generating a report or as complex as implementing a repeatable data scoring (e.g. segment allocation) or data mining process. In many cases it will be the customer, not the data analyst, who will carry out the deployment steps. Even if the analyst deploys the model it is important for the customer to understand up front the actions which will need to be carried out in order to actually make use of the created models.

Applying Machine Learning to Federal Immigration Disputes:
A Case Study of Applications Before Immigration, Refugee, and Citizenship Canada (IRCC)

Albert Yoon, JD-PhD[1]
Blue J Legal
18 June 2017

Prepared for Department of Justice Canada

Summary

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[1] Albert Yoon is a co-founder of Blue J Legal, Inc. He is also Professor and Chair in Law and Economics at the University of Toronto Faculty of Law. His academic research empirically examines judicial behaviour, the legal profession, and labour markets. He received his BA from Yale University, and his JD and PhD (political science) from Stanford University. Please send any comments to albert@bluejlegal.com.

Pages 1044 to / à 1065

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CSSP-2016-CP-2276   Chain of Trust: Collaborative Risk Assessment for Air Traveller Programs
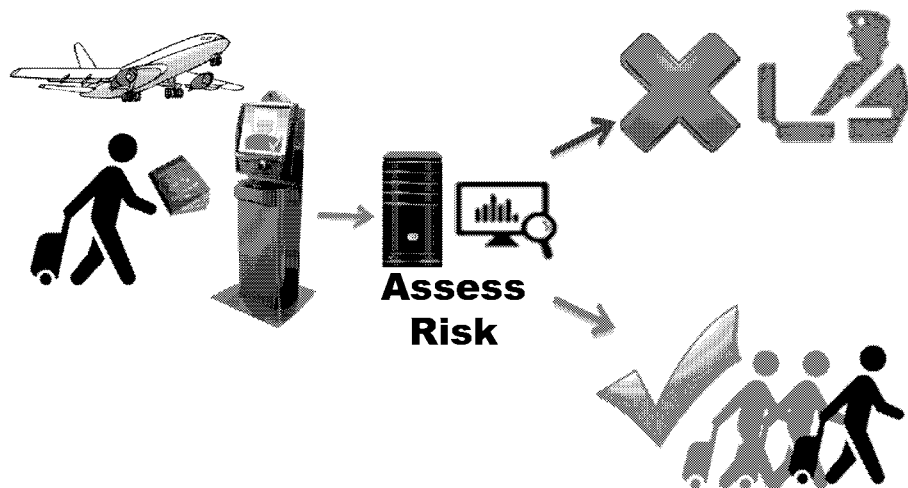
Lead : Immigration, Refugees and Citizenship Canada

Partnership: Canada Border Services Agency, WorldReach Software, Entrust Datacard, Face4 Systems, University of Ottawa

Start-End: November 2016 to March 2018

Funds:

CSSP Funds	Co-Investment Funds In-Kind	Cash	Total Funds
$1,296,523	$1,496,000	$0	$2,792,523

Project Summary:

Objectives:

- Demonstrate how new technologies and data sources can enhance the risk assessment of air travellers as they progress through the travel continuum.

- Demonstrate that low-risk travellers would benefit from faster service with minimal human contact, while high-risk travellers would be flagged for greater scrutiny.

Outcomes:

Deliverables:
- A prototype demonstrated in a representative environment.
- Four technology refinement reports documenting progress through iterative stages of prototype development
- An Evaluation Report, a Technology Dissemination Plan and an outline of a potential pilot

Impacts:
Aligned to Challenge #14
- Enhanced cross-agency collaboration and information sharing for risk assessment
- Improved service experience for low-risk travellers
- Enhanced targeting of persons-of-interest
- Improved capability for remote authentication of air travellers before departure to Canada

Canadian Safety and Security Program   The CSSP is led by Defence Research and Development Canada's Centre for Security Science, in partnership with Public Safety Canada.   Canada   11/09/2018

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CEC Predictive Dashboard

OPMB-PMU-DPAT
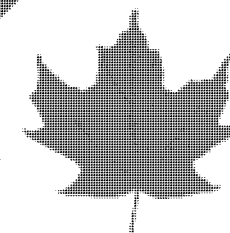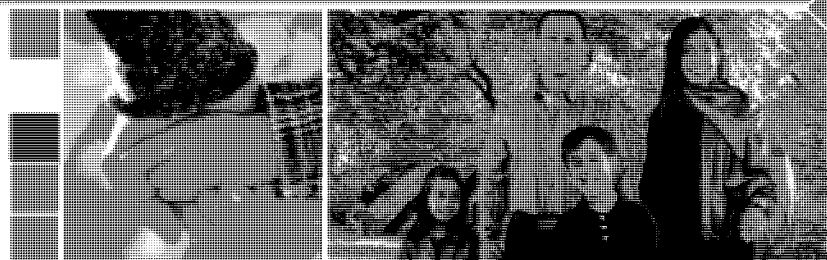
March 2015

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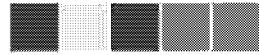
Why CEC Dashboard

- While we don't have the functionality to deploy a real predictive model in production, CEC dashboard was prepared by DMT and DPAT to test business rules provided by the model for possible auto-triaging and auto-assignment.

- The model has **rule sets** presented as **If ...Then...** statements that can be imposed on upcoming applications for triaging.

- This was coded description of the splits found by C5 algorithm (see Express Entry master modeling document for details).

- The outcome of application of these rules was assessed vs. actual final assessment of application in GCMS for accuracy in order to see if these rules could be used for future auto-triaging and auto-assignment.
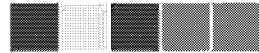
SPSS Decision Tree for CEC

- The interactive decision tree was built for CEC similar to FSW (see master document for details).
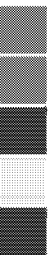
GCMS Data Overview to Define Business Rules Based on Model

- Number of application finalized between **July 16, 2011 and August 15, 2014**

- Total number of valid records consist of **26,477** applications

- Total number of custom fields (columns) is **2**

GCMS Methodology – Triage Rules

- CEC decision tree rules as identified by the SPSS modeller were transferred to GCMS in a series of case statements.

- Currently, this method is being used to validate the accuracy of SPSS triage rules vs. actual final assessment of GCMS application.

GCMS Answers – Case Statement

- Example of GCMS Case Statement using SPSS decision tree rules:

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A-2018-09320-001073

GCMS Triage Rule Outcome

The report outcome displays the Application Number along with:

* Triage Rules – defined by SPSS rules

* Final Assessment – actual final assessment of GCMS application

Title   𝐴△ ☑ ✕

CEC Triage Rules Development (Final Assessment Comparison)

Table   𝐴△ ☑ ✕

Next Steps

- Develop similar dashboard for FSW and PN if client need them

- Identify feasible and optimal number of cases to test and if necessary revise the model once actual data available

Unclassified

Canadian Safety and Security Program (CSSP) Project Charter

Chain of Trust: Collaborative Risk Assessment for Air Traveller Programs
CSSP-2016-CP-2276

Version: 1.0

Version 1.0: 26 JAN 2017

RECORD OF AMENDMENTS

Record major changes between final Charter versions; commencing at Version 1, initial Charter.

Charter Version No.	Amendment / Section Amended	Entered By	Amendment Date
Version 1.0	Initial Charter	Steven Gonzalez	26 January 2017

Charter Revision: Project changes that impact scope, budget or schedule require a full Charter revision and sign off by all participants. Charter Amendment: Project changes that are minor and do not impact scope, budget (with no impact to FY Cashflow) or schedule require a Charter Amendment and sign off by the Lead Government Department and DRDC CSS.

INTRODUCTION

1.   Purpose

The Project Charter is established between Defence Research and Development Canada, Centre for Security Science (DRDC CSS) and Project participants to acknowledge the existence of a project. The Charter outlines the parameters and structure of the project and includes project objectives; outcomes; impact; risks; schedule; resources; budget; and project organization. The Charter, itself, is not a contract. A contract or Memorandum of Agreement (MOA) must be issued through Public Works and Government Services Canada (PWGSC) to non-federal government partners prior to the commencement of any project activities.   In case of conflict, any resultant contract/MOA takes precedence over the Charter.

2.   Summary

This Project Charter hereby establishes Chain of Trust: Collaborative Risk Assessment for Air Traveller Programs (CoT) as a Project in accordance with the Canadian Safety and Security Program (CSSP) managed through DRDC CSS. This Call for Proposals project is being conducted primarily for the Border and Transportation Security Portfolio.

3.   CSSP Outcomes

This project contributes to the following CSSP Outcomes:

- Secure/Open Borders

- Effective Technology Assessment/Transition

4.   Background

The risk assessment of travellers entering Canada is a growing challenge given the rise in global security threats and the increasing sophistication of bad actors. In particular, visa-exempt extremists were identified as a top threat in Canada's 2014 Terrorist Report.

This project picks-up where FASTER-PrivBio left off by taking the proof of concept application and demonstrating it in a prototyping environment which includes operationally relevant systems and users.
The project addresses Challenge 14 "to enhance targeting solutions that make use of all available data, including electronic traveller data and biometrics, for the purposes of identifying low-risk travellers". It focuses on international travellers coming to Canada using the Electronic Travel Program (eTA) and returning Canadians (both via air). The project contains four key areas of activity:

- **Activity 1: Augmented App and Traveller facing systems**

   The Smartphone App and Traveller facing systems allow the collection of electronic data throughout the trip.

   a) Smartphone App: the FASTER PrivBio app currently allows the ability to obtain an eTA. The app will be extended to allow the submission of the E311 Declaration Form and will potentially support a broader range of phones.

   b) Kiosks and other traveller facing transactions: Check-in, boarding pass, boarding kiosk, declaration and primary kiosks are used in conjunction with the smartphone App throughout the trip. Examples of these systems within the airports of departure and arrival will be developed.

- **Activity 2: Back-end Systems**

   Backend systems allow transaction data to be stored, verified, consolidated, distributed and shared. The CoT system will mock-up various backend systems to demonstrate this ability.

Version 1.0: 26 JAN 2017

A-2018-09320-001079

FASTER eTA approval: The FASTER server system developed in FASTER PrivBio will be extended.

- **Activity 3: Collaborative Analytics**

- **Activity 4: Demonstration Prototype**

    A demonstration of how the prototype will result in faster service throughout the continuum for low-risk travellers, in exchange for quality information about themselves. The use of streaming and automated border controls/technology will lead to more efficient processing at the various stages of the continuum, with minimal human contact.

The ConOps for this prototype enables the *Air Border of the Future 2020* operational vision prepared by the CBSA and IRCC in 2014/15 with input from the air industry. The federal government stakeholders in the initial FASTER-PrivBio project will continue to support this new prototype proposal with their in-kind support and direct involvement across research, policy and operations.

This project offers significant potential to transform the travel experience of millions of travellers by implementing the ConOps to be demonstrated in the prototype in the air travel continuum. Surveys clearly indicate that consumers are eager to access government service through mobile or self-service models.

Pull demand from partners could include:

- IRCC and CBSA: enhance the security and efficiency of immigration and border enforcement programs through new sources of information,   and collaborative risk assessment.
- Stakeholders represented through IRCC/CBSA partners:
    o Public Safety Canada, including intelligence and enforcement bodies (Canadian Security Intelligence Service (CSIS) and the Royal Canadian Mounted Police (RCMP)
    o Travel/Air Industry Groups: Chain of Trust generates efficiencies by streamlining low risk travellers at airports.
    o U.S. Customs and Border Protection: Chain of Trust is consistent with the spirit of the Beyond the Border Action Plan.
    o Five Nations: Canada could provide an innovative solution by pushing out the border and sharing best practices.
    o International organizations, including the UN Security Council and International Civil Aviation Organization (ICAO).

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5.   Objective(s)

The objective of this prototype exercise is to identify the necessary requirements and target the overall proposed technology up to TRL 7. A demonstration of a prototype will be performed in a representative environment rather than an operational environment.

The CoT project will address CSSP Challenge 14 to enhance targeting solutions that make use of all available data, for the purposes of identifying low-risk travellers. This will be achieved by demonstrating a unique end-to-end technical solution that could be used to analyze the risk associated with a traveller from the moment an eTA application is received by IRCC to the moment when the traveller reaches a Canadian POE. This will facilitate the clearance of low-risk travellers, while helping to detect and deter potential terrorists before migration approval or entry into Canada.

From an internal stakeholder perspective, CoT could support:

a)   IRCC admissibility decisions by using predictive analytics to analyze relevant information about travellers prior to the issuance of an eTA.
b)   CBSA in its mandate to enable effective and efficient screening and more streamlined clearance of low-risk travellers across borders.
c)   The Beyond the Border Action Plan by supporting earlier identification of security threats.

6.   Impact on the CSSP Outcome(s)

Secure/Open Borders

The project demonstrates the possibility to improve border security by consolidating available information and introducing automated risk screening based on collaborative predictive analytics. This will help address a top national security threat identified in the 2014 Terrorist Threat to Canada Report.

The project enhances border openness because risk screening will allow IRCC and CBSA to streamline and facilitate the passage of low-risk travellers. Moreover, the facilitation of travel through the use of a mobile phone and secure biometrics authentication will make travel easier. The potential benefits are significant given that eTA clients represent 3.5 million travellers per year and returning Canadians represent an additional 17 million travellers per year. The mobile app will also allow travellers to complete the E311 Declaration Form on their phone, thus further accelerating border clearance.

Effective Technology Assessment/Transition
The project will allow the partners to assess how various technologies can contribute to risk triaging of travellers, including biometric authentication, data consolidation tools and predictive analytics. It will allow partners to evaluate how the level of risk evolves as the traveller generates new information while transitioning through various zones of the continuum.

These advancements will position Canada as a leader in pre-screening immigration applicants and facilitating low-risk traveller movement. They will also position the partners to potentially undertake a pilot.

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PROJECT SCOPE

The project brings together IRCC, CBSA and industry innovators in a thought-leading approach to apply new knowledge/technologies for collaborative risk assessment and establishment of the traveller identity throughout the traveller continuum.

7.   Included Work

3)   Extended ePassport testing

4)   Token Usage

Token creation and verification using the ePassport facial image was done in the initial FASTER-PrivBio project for verification at the border.

5)   Faces on the Move integration

6)   E311 Declaration

Prototyping of the FASTER mobile app integration with the E311 mobile Declaration Form will be done to illustrate the interoperability and facilitation of low risk traveller border entry.

7)   Cloud-based demonstration

FASTER-PrivBio uses commercial Cloud and WAN simulation tools for testing and simulating Internet connectivity used by eTA travellers to connect with IRCC. Access to a commercial cloud could be used for this prototype to simulate access to the IRCC /CBSA web sites and FASTER connections to the central servers.

8)   Interaction of transient and permanent data record

The collaborative risk aspect of the project proposes to establish a server component (possibly within the commercial cloud) to maintain a transient and dynamic record for each traveller that directly parallels the travel continuum. It is anticipated that this transient record, hereafter referred to as a Traveller Risk Profile, might be created at pre-departure and will be informed with additional information collected during the travel continuum, as well as with the collaborative predictive analytics risk assessments and potentially other data sources. We will also investigate how the status of the Traveller Risk Profile, and potential alerts resulting from the various interactions, might be made available to various operational stakeholders e.g. CBSA field officers (via web or dedicated User Interface (UI) tools) to provide real-time indication of progress against configured risk benchmarks, that might imply an alteration in the continuum flow. Upon completion of processing of the traveller

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through all zones of border control, it is expected that the Traveller Risk Profile structure would be recorded in a permanent Universal Travel Record (UTR) for that traveller.

9) Passport Renewals

Some prototyping will be explored of the online simplified renewal process for Canadian ePassports. This will involve scanning of the biopage in the ePassport as done in FASTER to obtain and validate the existing passport information as well as populate an application form.

10) Collaborative Analytics

The collaborative predictive analytics involves IRCC and CBSA each developing their own predictive models to assess the risk level of each traveller. IRCC's risk assessments will be shared with CBSA and incorporated into their own risk assessment. Additionally, CBSA's risk assessments will be updated as each traveller advances to a later zone in the continuum, thus generating new information that could influence the risk assessment. Pending the results of the analysis, IRCC may be in a position to begin modifying Global Case Management System (GCMS) to deploy predictive analytics models for risk assessment. For Canadians returning to Canada, CBSA will conduct its risk assessments alone, as IRCC plays no role in the screening.

11) Demonstration

Facilities will be obtained to host the prototype demonstration exercises. The project team will simulate the zones of the air travel continuum to assess how the prototype improves the overall travel experience of low-risk travellers in exchange for quality information about themselves. Equipment used for these simulations will include: kiosk technology, mobile devices, surveillance systems, data simulators, backend servers, and 'front counter' workstations.

8.   Excluded Work

The demonstration will take place in a representative environment, not an operational environment.

No real traveller information will be exchanged between partners or used during the technology demonstration. Risk indicators resulting from the predictive analytics will not be exchanged between partners. As a result, a Privacy Impact Assessment will not be required.

For the purpose of the technology demonstration, the cell phone application will not support all mobile operating systems.

9.   Assumptions
- The technology platform used in the technical demonstration exercises will be provided by WorldReach in their performance lab and development facilities
- All project team members will be available to perform their assigned tasks when required or suitable replacements will be identified.
- No real travellers or data will be part of the technology demonstration. Volunteers will be invited to participate in the demonstration using their ePassports.

10.   Constraints
- All partners must work within the constraints of existing programs, policies and infrastructure, which will likely remain in place for at least 2-3 years. This includes the features of the ePassport, the eTA program, border kiosk technology, mobile devices, Integrated Primary Inspection Line (IPIL), and the GCMS used by IRCC and CBSA.
- The mobile app can only be developed on the Android platform at this time for NFC access.

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11.   Related Projects

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- "Architecture and Assessment: Privacy Preserving Biometrically Secured Electronic Documents" (CSSP-2013-CD-1064): biometric encryption in the travel continuum and proposed the architecture which this prototype expands.

PROJECT PLAN

12.   Schedule and Work Breakdown Structure

12.1 Schedule: The Project started on 1 April 2017 and will be completed by 31 March 2018.

For Contract(s) or MOA(s) established under this project, the project activities will start upon issuance of Contract or MOA.

12.2 Work Breakdown Structure (WBS): The schedule shows the planned start and stop dates for each task in the WBS and appropriate milestones and/or delivery dates. The total Project period of performance is indicated in months from the start date through the completion date.

Task #	Description	Deliverable(s)	Performed By	Start Date	End Date
1. Initiation					
1.1	Initiation: Prepare Charter with overview of activities, resource requirements & roles of team members.	- Contracts - Project kick-off meeting - Go/No Go Decision for Execution	IRCC CBSA WorldReach Entrust UofO Face4	Apr/17	May/17
2. Execution					
2.1	Initial Design/Technical Briefing: Partners collaborate to further define ConOps and high level design, including: - Project Briefing - Point of View - Process and Information Flows - Technology Blocks	- Updated Concept of Operation - High-Level Design Report	IRCC CBSA WorldReach Entrust UofO Face4	Apr/17	May/17
2.2	Technology Refinement: Implementation of enhancements to current platforms in preparation for four iterations of a prototype. The following technology areas will	Four prototypes to be produced with increasing degrees of fidelity: - Technology Refinement Fidelity 1 (July 2017) - Technology Refinement Fidelity 2	IRCC CBSA WorldReach Entrust UofO Face4	May/17	Jan/18

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	be covered in this phase: - ePassport Interoperability - PrivBio - Collaborative Risk Engine Server & Traveller Risk Profile - IRCC Predictive Analysis - CBSA Predictive Analysis - Universal Traveller Record (UTR) - Face Recognition Identification	(September 2017) - Technology Refinement Fidelity 3 (November 2017) - Technology Refinement Fidelity 4 (January 2018)			
2.3	Technology Integration: Design and simulate integration points in preparation to the prototypes. The following technology areas will be covered in this phase: - Mobile Apps (FASTER, Passport Renewal, E311 Submission, MyCBSA) - Operational Support Mobile Apps (Checkpoint Assistance, Mobile Enforcement) - Kiosk Predictive Analytics and Risk Assessment (IRCC and CBSA) - Collaborative Risk Engine & Policy Enforcement Points - Backend Prototype Harnesses (e.g server integration FASTER to GCMS, -	Brief integration reports for each of the four prototypes: - Technology Refinement Fidelity 1 (July 2017) - Technology Refinement Fidelity 2 (September 2017) - Technology Refinement Fidelity 3 (November 2017) - Technology Refinement Fidelity 4 (January 2018)	IRCC CBSA WorldReach Entrust UofO Face4	May/17	Jan/18
2.4	Scenario Workshop: Drafting of scenarios for the prototypes aiming to closely simulate process/traffic flows through the different stages of the travel continuum.	- Draft Scenario Report - Exercise Logistics Plan Report - Walkthrough Exercise Findings Report - Project Review Committee - Go/No Go Decision for Technology Exercises	IRCC CBSA WorldReach Entrust UofO Face4	May/17	Jun/17
2.5 Technology Exercises					
2.5.1	Initial Setup Based on the Logistics plan and identified scenarios, the team will configure the technical environment and facility.	- Exercise Technical Environment Ready - Exercise Facility Ready	IRCC CBSA WorldReach Entrust UofO Face4	Jun/17	Jun/17
2.5.2 Conduct Exercises					
2.5.2.1	Fidelity 1 The identified scenarios will be	- Fidelity 1 Exercise Report	IRCC CBSA WorldReach	Jul/17	Jul/17

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	executed using the configured facility and technical environment. This first exercise primarily involves technology already available.		Entrust UofO Face4		
2.5.2.2	**Fidelity 2** Based on the observation of the Fidelity 1 exercise, the scenarios, facility and technical environments will be adjusted. A new release of the technical components will be installed. The updated scenarios will be executed using the refined facility and technical environment.	- Fidelity 2 Exercise Report	IRCC CBSA WorldReach Entrust UofO Face4	Aug/17	Sep/17
2.5.2.3	**Fidelity 3** Based on the observation of the Fidelity 2 exercise, the scenarios, facility and technical environments will be adjusted. A new release of the technical components will be installed. The updated scenarios will be executed using the refined facility and technical environment.	- Fidelity 3 Exercise Report	IRCC CBSA WorldReach Entrust UofO Face4	Oct/17	Nov/17
2.5.2.4	**Fidelity 4** Based on the observation of the Fidelity 3 exercise, the scenarios, facility and technical environments will be adjusted. A new release of the technical components will be installed. The updated scenarios will be executed using the refined facility and technical environment.	- Fidelity 4 Exercise Report	IRCC CBSA WorldReach Entrust UofO Face4	Dec/17	Jan/18
2.6	**Evaluation** Consolidate, report and present results from Technology Refinement, Technology Integration and Fidelity Exercises, including recommendation on next steps.	Final Report: - Evaluation Report - Technology Dissemination Plan - Outline of a potential pilot	IRCC CBSA WorldReach Entrust UofO Face4	Jan/18	Feb/18
3	**Project Close Out** Assess project deliverables against objectives and investments.	- CSSP Project Completion Report to document that all deliverables met their criteria and suggest potential technology transition options/follow-up items. - Close-Out Presentation - Project Review Committee Meeting Minutes	IRCC CBSA WorldReach Entrust UofO	Feb/18	Mar/18

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4. Ongoing Project Tracking and Reporting					
4.1	The following activities will be performed to successfully manage the project: - Consolidate/report on project financials to ensure proper communication to stakeholders. - Evaluate and track risks according to risk management plan. - Monitor project requirements against agreed scope. - Document changes for approval. - Manage milestones and time to completion to identify and communicate impacts to baseline schedule.	Progress Reports for the CSSP in: - August 2017 - November 2017 - February 2018 Year End Financial Report	IRCC CBSA WorldReach Entrust UofO	Apr/17	Mar/18

The Project will provide DRDC CSS with the following outputs (templates to be provided by DRDC CSS):
- Signed Project Charter
- Quad Chart
- Progress Reports
- YE Financial Report (for other government departments)
- Project Completion Report
- Record of Decision of Project Review Committee (PRC) meeting, if/when a PRC is held.

13.   Budget

13.1 CSSP Funds – as provided to the project by DRDC CSS (thousands of dollars)

Organization funds will be distributed to	General Ledger	CSSP Funds FY 17/18	CSSP Funds TOTAL
IRCC Contractor	4914	$237,000	$237,000
CBSA Salary	1105	$166,667	$166,667
CBSA EBP	1105	$33,333	$33,333
CBSA Equipment & Supplies	9233	$110,000	$110,000
CBSA Travel	2137	$10,000	$10,000
WorldReach	4915	$349,523	$349,523
Entrust Datacard	4915	$175,000	$175,000
University of Ottawa	4916	$135,000	$135,000
Face4	4915	$80,000	$80,000
Total		$1,296,523	$1,296,523

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13.2
In-Kind Co-Investment

Organization Providing	General Ledger	FY 16/17	FY 17/18	TOTAL
IRCC	1101	$26,000	$159,000	$185,000
CBSA	1101	$15,000	$329,000	$344,000
WorldReach	4915	$20,000	$550,000	$570,000
Entrust Datacard	4915	$4,500	$170,500	$175,000
University of Ottawa	4916	$9,500	$100,500	$110,000
Face4	4915	$4,200	$107,800	$112,000
Total		**$79,200**	**$1,416,800**	**$1,496,000**

14.   Resource Requirements

14.1 Personnel (DRDC CSS and Lead)

Name/Role	FY 16/17	FY 17/18	Total
I – Project Director, DRDC CSS	0.1	0.1	0.2
Simon Cardinal– Project Champion, IRCC	0	0.1	0.1
Steven Gonzalez – Project Manager, IRCC	0.2	0.25	0.45
Mike Haymes – Data Scientist, IRCC	0.5	1.0	1.5
Heather Elgee – Communications Advisor, IRCC	0.1	0.1	0.2
Tony Mungham – Deputy Project Manager, CBSA	0.2	0.2	0.4
Mehdi Tabib – Manager, Advanced Analytics, CBSA	0.1	0.1	0.2

14.2 Facilities and Equipment

The following equipment and facilities will be required for the Project:
- CBSA facility in Rigaud for the final demonstration (TBC).
- A performance lab will be required throughout the duration of the project.

15.   Risks

Risk	Probability (H/M/L)	Impact (H/M/L)	Type	Mitigation Strategy
Insufficient number of volunteers for the demonstration	L	H	Scope	
Insufficient variety of passports to test the broad applicability of the prototype	L	H	Scope	

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Regulatory/policy framework for border management unready for Chain of Trust	L	M	Scope	A government policy team at IRCC is already analyzing legal and privacy factors to be considered in the development of the technology/concept.
Diverging interests of commercial partners related to IP	M	M	Scope	Commercial partners to meet while Charter is being drafted to reach agreement or revise their level of participation
IRCC or CBSA programs not ready to assist or implement technology	M	H	Scope	IRCC and CBSA stakeholders have initial buy-in and will be given regular project updates. Stakeholders will also be involved in the Project Exercises to ensure Project momentum.
Lack of available low-cost facilities for the demonstration	M	M	Cost	Combination of IRCC and CBSA resources allow sufficient alternatives.
eTA data is of insufficient quality to enable the development of predictive models	L	H	Technical	The eTA Operations team is working closely with the GCMS team to ensure that data quality is very high, notably through a web-based application form containing mandatory fields and by replacing open text fields with drop-down menus.
Predictive models are incapable of finding patterns in the data	L	H	Technical	IRCC can hire very experienced consultants to complement its extensive in-house expertise on model development. Positive results obtained for other lines of business will be leveraged for eTA.

Note 1: (H/M/L) = high, medium or low

Note 2: Examples of `Risk Type` include: financial, schedule, scope, technical

16. Evaluation of Project Success

The Chain of Trust project will be evaluated based on the following criteria:
1. The smartphone is able to capture all the information from an E311 Declaration Form.
2. The smartphone is able to submit E311 information in a secure manner
3. The smartphone is able to demonstrate how to populate a mobile ePassport renewal application with relevant passport data.
4.

5. The IRCC predictive model is able to triage eTA applicants into high, medium and low risk groups.
6. The CBSA predictive model is able to incorporate IRCC's risk assessment and new data collected during the trip to triage travellers into high, medium and low risk groups.
7. Scenarios are conducted to test the project concepts which includes:
    a. a sequence of checkpoints and information flows to support continuous risk assessment (ex. self-serve enrolment, adjudication of application information, pre-boarding checkpoint, Primary Inspection, Mobile, Egress)
    b. Volunteer users acting in the roles of travellers and operational personnel
    c. Reporting on traveller throughput statistics
8. A document which describes the integrated system and the results of each scenario test.

17. Procurement Strategy

This project was approved through the call for proposal process. DRDC CSS will transfer funds to IRCC and CBSA. IRCC will establish a contract with WorldReach Software, while CBSA will establish contracts with the University of Ottawa, Entrust Datacard and Face4 Systems. Payment will be firm fixed price with milestone payments.

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18.   Transition Strategy

The prototype will be delivered in collaboration with the federal operational stakeholders. This will ensure a strategic/legislative fit within Canada's overall borders/immigration, identity management, law enforcement/intelligence strategies.

The reports and non-confidential deliverables of this prototype will be made available within Government and the partners in the project who undertake to assist in the promotion of the results and leverage the knowledge gained via the prototype. The project team will prepare next step recommendations as part of the technology dissemination plan deliverable to be prepared at the end of the project.

Demonstrated capabilities of this prototype will create leave-behind knowledge, technology, policy inputs and operational benefits to IRCC, CBSA and other stakeholders/partners during and after the project. Once confidence in the prototype has been established, the team could recommend a pilot, which could include:

- Strategic approval for the pilot by lead departments;
- Costing of the pilot and identification of funding sources;
- Technological inputs to immigration/border strategies, plans etc.;
- Further research/development required to take the pilot forward;
- Formal Threat Risk Assessments and Privacy Impact Assessments by relevant stakeholders;
- Policy Development and Approval processes;
- Contribution to international presentations such as ICAO and industry forums;
- Procurement of key components and provision of detailed proposals for implementation.

With the involvement of Treasury Board and the lead departments, additional opportunities for other uses of the science/technology could be identified for secure identification and authentication in a privacy respecting manner such as:

- Virtual Passport
- "Know your customer/citizen" tests;
- Trusted traveller enrolment;
- Other government e-services

Consideration will be given to invite representatives of the Five Country Conference (FCC) to have observer assigned to the project who may observe key exercises or volunteer to participate in testing. This will help to align approaches across the FCC and facilitate information sharing and best practices.

PROJECT SUPPORT

19.   Project Organization

Role	Name	Organization	Phone Number	Email Address
Project Leader	Mark Williamson	DRDC CSS	613-944-8195	Mark.Williamson@forces.gc.ca
Project Director	Brian Greene	DRDC CSS	613-943-0751	Brian.Greene@forces.gc.ca
Project Champion	Simon Cardinal	IRCC	613-437-6289	Simon.Cardinal@cic.gc.ca
Project Manager	Steven Gonzalez	IRCC	613-437-5556	steven.gonzalez@cic.gc.ca

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Contracting Authority	Heather Wilson	PWGSC	873-469-4791	heather.wilson@tpsgc-pwgsc.gc.ca
Deputy Project Manager	Tony Mungham	CBSA	613-954-3785	Tony.Mungham@cbsa-asfc.gc.ca
Technical Authority/ Principal Investigator	David Bissessar	CBSA	613-952-3163	David.Bissessar@cbsa-asfc.gc.ca
Industry Partner		WorldReach Software	613-742-6482	@worldreach.com
Industry Partner		Entrust Datacard	613-270-	@entrustdatacard.com
Industry Partner		Face4 Systems	613-656-3709	@face4systems.com
University Liaison		University of Ottawa	613-562-5800 ext.	@uottawa.ca

20.   Relevant Agreements/Arrangements

Intellectual Property (IP) will be managed in accordance with the General Conditions – Research & Development 2040 and specific clauses. These will be outlined in the Contract General Conditions.

Within the CSSP Program, Canada is utilizing the Commercialization in Canada clause to manage the Foreground information. Within the clause, the contractor will own any Foreground IP that is created as part of that contract or memorandum of agreement.

Transfers of funds to CBSA will be managed in accordance with the terms and conditions set out in the Public Security Science & Technology (PSTP) MOU between the Department of National Defence and various other Federal Departments and Agencies, including the Canada Border Services Agency, which is a signatory to the MOU (DND Identification Number: 2008040021).

Transfers of funds to IRCC will be managed in accordance with the terms and conditions set out in the Interdepartmental Letter of Arrangement (ILOA) between the Department of National Defence and Immigration, Refugees and Citizenship Canada.

21.   Other Information

IRCC Interdepartmental Settlement (IS) codes:
　　　Department Code : 085
　　　Reference Code: 3910
　　　Organisation Code: 9000

CBSA Interdepartmental Settlement (IS) codes:
　　　Department Code : 085
　　　Reference Code: TBC
　　　Organisation Code : 3910

22. Communications

DRDC CSS reserves the right to disclose and/or use information from projects for which it provides funding, including the publication of a short project description on science.gc.ca/cssp. Should you have any concerns about project information being posted on the website, please discuss them with your DRDC CSS Project Director during the charter development stage. Additionally, the use and publication of information related to this Project will require review by DRDC CSS to ensure proper acknowledgement of DRDC CSS/CSSP support/contribution. In order to achieve this, Project participants will provide copies of any reports, articles, or publications to DRDC CSS at least 30 days, where possible, prior to any release, distribution or planned publication. No public announcements concerning this Project will be made without providing advance notification to DRDC CSS. Project Managers and Directors should ensure that communications are executed through a coordinated approach that favours the development of joint products and activities. DRDC CSS must receive a copy of all reports generated under the Project.

23. Publication/Security/Controlled Goods/Distribution

The highest level of security to be applied to information generated or exchanged by or in this Project will be Protected B; a Security Requirements Check List (SRCL) will be required.

The distribution of information resulting from this Project is Limited. Where limited, distribution is limited to the following: federal government departments and agencies, as well as project partners.

24. Project/Charter Amendments

Any revision to or extension of this Project will be made through a formal amendment to this Project Charter, as concurred in writing by the participants.

25. Project Termination

DRDC CSS, in consultation with the Lead Government Department, will make recommendations regarding the termination of a Project, whose decision will be final.

Some conditions that may lead to termination could include:

- Charter has not been signed by project participants within three (3) months of project award.
- Deliverables / Milestones not met (non-performance).
- Forecast inability to deliver (for example, key personnel have left the department or Project).
- Failure of a participant to meet contractual obligations or PSTP MOU reporting requirements.
- Change in CSSP strategic priorities or science and technology requirements.
- Lead Government Department no longer leading the research study.

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SIGNATURES

This Project Charter will enter into effect on the date of the last signature, and will remain in effect until the completion of the project as outlined in Section 12.1, Schedule.

_____   2017/03/08
Simon Cardinal, A/Director General, IRCC   Date

_____   _____
Phil Lightfoot, Director, Border Technology Division, CBSA   Date

_____   _____
                WorldReach Software Corporation   Date

_____   _____
                Entrust Datacard   Date

_____   _____
        Professor, University of Ottawa   Date

_____   _____
                Face4 Systems Inc.   Date

_____   _____
Mark Williamson, Director General, DRDC CSS   Date

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SIGNATURES

This Project Charter will enter into effect on the date of the last signature, and will remain in effect until the completion of the project as outlined in Section 12.1, Schedule.

_____
Simon Cardinal, A/Director General, IRCC   Date

_____
Phil Lightfoot, Director, Border Technology Division, CBSA   Date   23/3/17

_____
WorldReach Software Corporation   Date

_____
Entrust Datacard   Date

_____
Professor, University of Ottawa   Date

_____
Face4 Systems Inc.   Date

_____
Mark Williamson, Director General, DRDC CSS   Date

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SIGNATURES

This Project Charter will enter into effect on the date of the last signature, and will remain in effect until the completion of the project as outlined in Section 12.1, Schedule.

_____

Simon Cardinal, A/Director General, IRCC   Date

_____

Phil Lightfoot, Director, Border Technology Division, CBSA   Date

_____   *March 2, 2017*

WorldReach Software Corporation   Date

_____

Entrust Datacard   Date

_____

Professor, University of Ottawa   Date

_____

Face4 Systems Inc.   Date

_____

Mark Williamson, Director General, DRDC CSS   Date

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SIGNATURES

This Project Charter will enter into effect on the date of the last signature, and will remain in effect until the completion of the project as outlined in Section 12.1, Schedule.

_____
Michael Olsen, Director General, IRCC   Date

_____
Phil Lightfoot, Director, Border Technology Division, CBSA   Date

_____
            WorldReach Software Corporation   Date

                                          March 28, 2017
_____
        VP Professional Services, Entrust Datacard Limited   Date

_____
        Professor, University of Ottawa   Date

_____
            Face4 Systems Inc.   Date

_____
Mark Williamson, Director General, DRDC CSS   Date

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SIGNATURES

This Project Charter will enter into effect on the date of the last signature, and will remain in effect until the completion of the project as outlined in Section 12.1, Schedule.

_____   **Date**
Simon Cardinal, A/Director General, IRCC

_____   **Date**
Phil Lightfoot, Director, Border Technology Division, CBSA

_____   **Date**
WorldReach Software Corporation

_____   **Date**
                              Entrust Datacard

                         _____
                                                                   Date
                                                               MAR - 6 2017

     ⌣⁓------   uOttawa
_____   **Date**
     , Face4 Systems Inc.

_____   **Date**
Mark Williamson, Director General, DRDC CSS

Version 1.0. 26 JAN 2017

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Simon Cardinal, A/Director General, IRCC   Date

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WorldReach Software Corporation   Date

Entrust Datacard   Date

Professor, University of Ottawa   Date

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2 march 2017

Face4 Systems Inc.   Date

---

31 mv 2012.

-Mark Williamson, Director General, DRDC CSS   Date

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Canada Border   Agence des services
Services Agency   frontaliers du Canada

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Chain of Trust (CoT)
Initial Design Workshop Outcomes

s.16(1)(b)

s.16(2)

Date: June 1, 2017   Reference: CoT20170601

Background:

The Science and Engineering Directorate (S&E) at the Canada Border Services Agency (CBSA) led a five-day workshop from May 8th to May 12th, 2017 to determine the high-level design of the prototype for the Chain of Trust: Collaborative Risk Assessment for Air Traveller Programs project. This is a project under the Canadian Safety and Security Program (CSSP) - CSSP-2016-CP-2276. The workshop was based on the principles of design thinking and rapid prototyping. Annex 1 lists the project resources who attended the workshop.

The Chain of Trust project addresses the CSSP Challenge 14 from the 2016 CSSP Call for Proposals: Enhance targeting solutions that make use of all available data, including electronic traveller data and biometrics, for the purposes of identifying low-risk travellers. The project focuses on international travellers coming to Canada using the Electronic Travel Program (eTA) and returning Canadians (both via air). The project contains three key areas of activity:

- Collection of high quality data earlier in the travel continuum.

  This data collection will be possible through enhancements to the FASTER PrivBio smartphone app (developed through a previous CSSP Project), which will also include the ability to complete the E311 Declaration Form online and will support a broader range of devices.

- Consolidating available data inputs   collected throughout the travel continuum into a new transaction record (the Traveller Risk Profile or TRP) to enhance resolution of the traveller identity and provide inputs into risk assessments. Each TRP will update the Traveller Passage Record (TPR) containing both specific data from the TRP record and historical traveller data.

- A privacy-respecting, collaborative predictive analytics approach by IRCC and CBSA leveraging historical traveller information and trip-related electronic data collected throughout the journey Collaborative predictive analysis will be updated as new information about the traveller is collected throughout the continuum to inform the risk triage of travellers so that low-risk

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travellers benefit from expedited processing while high-risk individuals are flagged for greater scrutiny.

The Chain of Trust (CoT) project brings together Immigration Refugee and Citizenship Canada (IRCC), the Canada Border Services Agency (CBSA), Industry (WorldReach Software, Face 4 Systems, Entrust Datacard), as well as academia (University of Ottawa) in a thought-leading approach to apply knowledge/technologies for collaborative risk assessment and establishment of the traveller identity throughout the travel continuum.

The work follows an agile and iterative methodology. The work commences with this baseline design workshop and will be followed by four exercises. Each exercise will involve design refinement, scenario development, technical development, and the execution of the exercise, followed by results assessment to inform the next exercise.

Exercises are in in a staged environment and include all project partners. The exercises will not deal with real travel transactions. Rather, they will make use of actors using mock data to represent travellers, border and immigration resources.

The project will end with an evaluation report that will describe what worked well and what did not work, and make recommendations for a future pilot that would exercise the concept in a real travel environment.

Prototype Stakeholders and Their Needs:
There are a number of stakeholders that will benefit from the concepts related to CoT, or who have an interest in the concept. The prototype will focus on meeting the direct needs of the IRCC eTA and Passport programs as well the CBSA programs related to air travel by informing the risk triage of travellers so that low-risk travellers benefit from expedited processing while unknown and/or high-risk travellers are flagged for greater scrutiny. However, the pilot will also take into consideration the benefits and interactions of other stakeholders involved in the air travel continuum.

The Chain of Trust Prototype will focus on the following stakeholders:

International air traveller requiring an eTA: This is a traveller from a foreign country who wishes to come to travel Canada and needs a valid eTA in order to travel to Canada

Canadian traveller returning to Canada via air: This is a Canadian traveller who wishes to return to Canada and needs a valid Canadian Passport in order to travel to Canada

Airline: This is a commercial organization that provides the air travel to the traveller, The Airline must sell the traveller a ticket, must validate that the traveller has a valid Passport or eTA (if required), and

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must send API/PNR info to the CBSA at set intervals in the travel continuum (72Hrs, 48Hrs, 24Hrs, and Wheels Up).

IRCC ETA Review: This is a group at the IRCC that reviews applications for an ETA and either approve or denies the issuance of an ETA. The IRCC ETA Review group needs sufficient information in order to review an ETA application

IRCC Passport Renewal: This is a group at the IRCC the reviews renewals for passports and either approves or denies the issuance of a passport. The IRCC Passport Renewal group needs sufficient information in order to review a Passport Renewal.

CBSA Client Service: This is a group at the CBSA that maintains an electronic conversation with a traveller in order to establish a trusted rapport with the traveller and promote compliance. The CBSA client service group needs a method to communicate with the traveller in a privacy preserving manner.

CBSA Targeting: This is a group at the CBSA that reviews information on a traveller in order to determine if a traveller requires administrative facilitation or enforcement examination. The CBSA Targeting group needs sufficient traveller and related information to perform a risk assessment on a traveller or group of travellers.

CBSA POE Administration: This a group at the CBSA that manages the deployment of CBSA resources at an international airport. This group can have a scope that is local to an airport and/or national across the country. The CBSA POE Administration need sufficient near real-time information related to the movement and processing of travellers in order to effectively deploy CBSA resources.

The CBSA Mobile Enforcement Officer: This is a group at the CBSA that moves around the various travel zones at an airport and interacts with travellers in order to identify possible non-compliance. The CBSA Mobile Enforcement Officers need sufficient near real-time traveller information and the ability to communicate with each other and a command centre in order to detect and interdict non-compliance.

The CBSA Mobile Enforcement Command: This is a group at the CBSA that monitors through overt surveillance the movement and behaviour of travellers in order to identify travellers that require an interaction with a Roving Officer, and directs a roving officer to the traveller. The CBSA Mobile Enforcement Command needs to see the movement and behaviour of the travellers, have sufficient information to develop indicators of possible non-compliance, and be able to communicate remotely and efficiently with the roving officers

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Design Point of Views:

A point-of-view (POV) is the reframing of the design challenge into an actionable problem statement that will launch the design team into generative ideation. The POV creates How-Might-We questions that facilitate the designers to ideate in a directed manner. The POV captures the design vision from which the design team discovers and articulates the meaningful challenge.

Data Collection:
How might the design team collect data about a traveller as early as possible and as often as possible throughout the travel continuum?

Data Consolidation:
How might the design team continually consolidate the collected traveller data to enhance the resolution of the traveller identity and provide inputs into risk assessments?

Identify and Expedite Low Risk Travellers:
How might the design team implement systems to identify low-risk travellers who will benefit from expedited/self-service processing while high-risk travellers are flagged for examination by IRCC and CBSA officers.

Prototype Zones and Stakeholder Interactions:

The Chain of Trust prototype will be divided into discrete travel zones. Each zone is a boundary that describes either a logical aspect of the system and/or physical location of a traveller during an interaction with the Chain of Trust system(s). Below are the travel zones that will be considered during the prototyping of the Chain of Trust System. Each zone is described along with an overview of the interactions that take place:

Intent to Travel Zone	
A traveller shows an intent to travel by either applying for an ETA, renewing a Passport, or initiating a conversation with the CBSA. This zone is a logical zone and does not have a defined physical location.	
Traveller's Perspective	**IRCC/CBSA Perspective**

Trigger:
   • The traveller intends to travel
Actions:
   • Renew Passport (Canadians only - if applicable)
   • Get eTA (if applicable)
   • Download the e-Declaration App (optional)
   • Start conversation with CBSA/IRCC (optional)
	Trigger:
	   • The traveller has indicated an intent to travel
	Actions:
	   • IRCC ETA Review/IRCC Passport Renewal receives application for eTA/passport renewal
	   • IRCC IRCC ETA Review/IRCC Passport Renewal provides or denies eTA/passport renewal
	   • CBSA Client Service responds to initiative conversation
	      o Pushes info to promote compliance

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Buy a Ticket Zone

A traveller initiates an interaction with an airline through purchasing a ticket and the airline initiates API data sharing with the CBSA. This zone is a logical zone and does not have a defined physical location.

Traveller's Perspective	CBSA Perspective

Trigger:
• The traveller buys a ticket to Canada
Actions:
• Commits to travel
• Provides personal information and payment
• May check-in if within 24 hours (optional)
   ○ If so, the traveller would provide information about luggage and passport number
   ○ The traveller may make a pre e-Declaration (optional)
• Downloads the e-Declaration App
• Continues conversation with CBSA/IRCC
	Trigger:
	• 72 hours before the traveller is going to travel
	Actions:
	• CBSA Targeting receives partial API from the airline company (no PNR details)
	• CBSA risk assessment starts
	
	Trigger:
	• 48 hours before the traveller is going to travel
	Actions:
	• CBSA Targeting receives the updated partial API from the airline company (no PNR details)
	• CBSA risk assessment continues
	
	Trigger:
	• 24 hours before the traveller is going to travel
	Actions:
	• CBSA Targeting receives updated API and partial PNR from the airline company
	• CBSA risk assessment continues

Pre Departure Zone

A traveller arrives at an airport and goes through the departure process at the airport. For the purposes of the Chain of Trust Prototype, this includes boarding the aircraft. This is a logical zone and is physically at a departure airport.

Traveller's Perspective	CBSA Perspective

Trigger:
• The traveller arrives at the airport
Actions:
• Checks-in luggage
• Clears security
• Arrives at the gate
• Shows travel documentation
• Boards plane
• Downloads the e-Declaration App (optional)
• Makes/updates the pre e-Declaration (optional)
	Trigger:
	• The traveller arrives at the airport
	Actions:
	• The airline checks the traveller's document
	• The airline accepts luggage
	• CBSA risk assessment continues
	• CBSA commits travel as passage (program policy commit)
	• Airline Checks and validates passenger
	   ○ The airline checks CBSA for board/no-board,
	   ○ The airline validates boarding (multiple is possible)

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Pre Arrival Zone

The traveller is on an aircraft and is on route to Canada. This is a logical zone and is physically represented by an aircraft on route (wheels-up).

Traveller's Perspective	CBSA Perspective

Trigger:
• Wheels Up – Flight headed to Canada.
Actions:
• Completes e-Declaration App (optional)
• Submits e-Declaration (optional)
	Trigger:
	• Wheels Up – Flight headed to Canada.
	Actions:
	• CBSA Targeting receives final API and full PNR from the airline company
	• CBSA POE Admin plans for traveller flow
	• CBSA makes recommendation for referrals based on:
	
	• CBSA POE Admin planning
	  ○ Reviews indicators
	  ○ Prepares response
	  ○ Gets updated arrival times from airline
	  ○ Updates Dashboard for Ops

Arrival Zone

The traveller disembarks an aircraft. This is a logical zone and is physically represented by an aircraft arriving at a terminal, passengers disembarking, and moving towards the primary zone.

Traveller's Perspective	CBSA Perspective
Trigger: • The traveller disembarks the airplane (traveller may indicate arrival) Actions: • Completes e-Declaration (optional) • Make finals e-declaration though mobile (optional) • Gets recommendations for next steps (optional) • Gets next step from CBSA (where to present themselves)	Trigger: • The traveller disembarks the airplane (traveller may indicate arrival) Actions: • CBSA Client Service sends the traveller a wait-time notice for the kiosk • CBSA POE Admin updates arrival instance • CBSA accepts final declaration and enrols the traveller into passenger flow control (optional – if ID was validated by CBSA previously) • CBSA risk assessment continues • CBSA POE Admin receives risk assessment details • CBSA tells traveller next step • CBSA ME Command and CBSA Rover observe behaviours • CBSA ME gets indicators • CBSA ME intercepts known threats • CBSA ME and ME Command updates risk assessment attributes

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Primary Zone

A traveller presents themselves to CBSA and makes a final declaration. This is logical zone and for the Chain of Trust prototype it is physically represented at a Primary Kiosk in the arrivals hall of the CBSA or through a smartphone transaction in either the arrival area of Canadian airport or the arrival area of the CBSA.

Traveller's Perspective	CBSA Perspective
Trigger: • The traveller arrives at the kiosk or initiates primary processing on a smartphone Actions: • presents face • scans e-travel docs (optional for travellers with low level of assurance) • makes final declaration • gets recommendations for next step	Trigger: • The traveller arrives at the kiosk or initiates primary processing on a smartphone Actions: • CBSA POE admin monitors and adapts traveller flow based on volume • CBSA validates the traveller's documentation and ID • CBSA enrols the traveller into passenger flow control • CBSA accepts final declaration and enrols the traveller into passenger flow control (optional) • CBSA risk assessment continues • CBSA POE Admin receives risk assessment details • CBSA ME and ME Command observe behaviours • CBSA ME gets indicators • CBSA ME intercepts known threats • CBSA ME and ME Command updates risk assessment attributes • CBSA tells traveller next step

Intermediate Zone

The traveller completes any required administration transactions that do not require examination of goods or immigration documents (such as the payment of duties and taxes). This is a logical zone and is physically either at a kiosk (self-service) or service counter (border officer/clerk assistance).

Traveller's Perspective	CBSA Perspective
Trigger: • The traveller is sent to the Intermediate zone Actions: • Complete non immigration administrative tasks (pay taxes, duties, fees; get permits; etc.) • Complete immigration tasks that do not require examination	Trigger: • The traveller goes to the Intermediate zone Actions: • CBSA validates traveller location with flow control system • CBSA processes administrative task • CBSA risk assessment continues • CBSA POE Admin receives risk assessment details • CBSA ME and ME Command observe behaviours • CBSA ME gets indicators • CBSA ME intercepts known threats • CBSA ME and ME Command updates risk assessment attributes • CBSA tells traveller next step

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Secondary Zone

A traveller is examined by a border services officer for either customs and/or immigration purposes. This is logical zone, and will not be physically represented in the chain of trust prototype.

Traveller's Perspective	CBSA Perspective
Trigger: • The traveller is sent to Secondary Actions: • Answer questions • Present goods • Present documents	Trigger: • The traveller arrives at Secondary Actions: • CBSA validates traveller location with flow control system • CBSA gets the reason why they have been sent to Secondary • CBSA notes the results of the exam • CBSA updates the risk assessment • CBSA POE Admin adapts to traveller flow

Egress Zone(s)

A traveller exits the CBSA processing area and enters Canada. This is both logical zone and physical zone that is represented by the final control point and/or one or more verification point(s) in the CBSA processing area.

Traveller's Perspective	CBSA Perspective

Trigger:
• The traveller is trying to exit the CBSA processing area
Actions:
• Present themselves
• Follow directions (they are released or referred back to a point in the process)
	Trigger:
	• The traveller arrives at the Egress location
	Output:
	• CBSA POE Admin monitors and adapts traveller flow
	• CBSA validates traveller location with flow control system
	• CBSA ME gets indicators
	• CBSA ME intercepts known threats
	• CBSA ME and ME Command observe behaviours
	• CBSA ME and ME Command updates risk assessment attributes
	• CBSA risk assessment continues
	• CBSA tells the traveller next step:
	   o "Refer" – the traveller is sent to Secondary
	   o "Release" – the traveller can leave the airport
	   o If released → CBSA closes the passage

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Policy Risk Assessment Concept:

The prototype design is starting with the concept that there are three overarching policy themes: immigration concerns, customs concerns, and overall public safety concerns. Each policy theme comprises of a set of policies (policy map) that are determined by the characteristics of the traveller. For example, a returning Canadian would have a set of policies that are different from a foreign national that requires an ETA. A set of policies is made of individual policies that are essentially individual questions that contribute to understanding the characteristics of a traveller. The result of a policy can come from many sources such as testing a rule with given parameters, the results of a database search, or the results of predicative analytics. The result of a policy can also drive branching policies that further clarify the characteristics of a traveller. There are two types of policies:

1) Scoring policies work together to establish the characteristics of risk associated to an instance of a traveller moving through the border. Each scoring policy has a score to indicate the level of concern, and each score can result in a state of either

    ! The thresholds to change the policy state from one result to another is operationally dependent.

2) Trigger policies are used to drive the workflow. These are typically if-then logic and trigger the next action within the prototype system.

Thus, each traveller would have a cluster associated to them and this cluster is based on a dynamic set of policies that evolves over time as the characteristics of a traveller are assessed and/or determined.

Figure 1: Example of Policy Questionn

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Predictive Analytics

The heart of the Chain of Trust prototype is predictive analytics. The predictive analytics uses machine learning to identify patterns that can be used to inform downstream processes. This prototype will have two distinct predictive analytic engines: one for the IRCC related to the issuance of ETAs, and the other for the CBSA that will be related to the indication of non-compliance of travellers. Both engines are based on organizational specific program policy coverage, so the results will be shared through the risk assessment collaboration tools that will ensure programs policy coverage and limits are respected.

Risk Assessment and Workflow Orchestrator

The ability to manage the individual policies, the policy maps, and to execute the risk assessment in a collaborative way is accomplished by an orchestrator that will manage the risk assessment and the dynamic rules/risk based workflow of a traveller.

Managing Privacy through the use of Renewable Biometric References

The Chain of Trust prototype will be linking travel documents, travel credentials, and risk characteristics to a traveller through the use of biometrics, but this will be done by creating a Renewable Biometric Reference (RBR). A RBR is derived and verified from a live biometric through the use of cryptography without storing the actual biometric and/or biometric template. The biometric cannot be reconstructed from the RBR but the RBR can be verified against a live biometric.

The use of RBRs as opposed to traditional biometrics allows the CBSA and IRCC to link people to travel credentials and risk characteristics without storing and managing the private biometric information of tens of millions of travellers. It removes the risk of "loosing" biometric information if a system is attacked or compromised by providing a mechanism to revoke/cancel and regenerate RBRs all while never storing the actual biometric information itself.

Face Recognition Based Flow Control

The prototype will be using and testing the effectiveness Face Recognition (FR) on the move to manage the flow of travellers within the CBSA processing area at an airport. The traveller will be enrolled into the FR flow control system during the primary zone interaction, and choke points with FR verification will be used to manage the flow of travellers as they move from one zone to another zone. The most important zone to ensure a high level of integrity is the final egress zone. In this zone, the traveller is either directed back for further processing/examination or is allowed to enter Canada. Once the Traveller has completed border processing (e.g.: is allowed to enter Canada), the traveller is unenrolled from the FR flow control system.

Vision Box Orchestra

During the design sessions the idea of using existing software to help visualise and manage the flow of travellers within the CBSA processing area was discussed. A third party vendor named Vision Box has a software tool called Orchestra. The project will look into using Orchestra in order to capitalize on existing capabilities, thus allowing the project to focus on new and untested platforms.

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Prototype System Interactions:

The prototype system interaction is represented as a block diagram. The diagram below shows the major technology blocks and indicates the links between the individual blocks.

Figure 2: Chain of Trust Block Diagram

Prototype Scenario Storyboards:

The prototype is an end-to-end concept that will be tested through a set of exercises that are based on a number of stories. Each of the stories will test various aspects of the system while driving a variety of outputs. If the output occurs as predicted, the design is working as planned. However, if the output was unpredicted, it may be necessary to review and update aspects of the design

Stories are an effective means to coordinate a common purpose in scope. They ensure that all project partners are working towards the same desired outcome allowing independent work to align to a single goal. The Chain of Trust design will be initially tested based on the four baseline scenarios. However, it is

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likely that additional stories will be created over time in order to ensure certain aspects of the prototype are tested.

The four baseline scenario storyboards that were created during the initial design workshop are described below. These stories will be elaborated into a narrative and reviewed by all project partners before the first exercise as the story narrative is core to the planning of each exercise.

Scenario #1 – Broken RBR:
1. Canadian traveller arrives
2. Submits eDeclaration
3. Overlimit →   traveller directed to Intermediate
4. Traveller pays fees at intermediate kiosk, but the RBR fails →   traveller directed to Secondary
5. (Back office alerted → Rover dispatched to find traveller)
6. Rover finds traveller, checks face

Scenario #2 – Missing bag:
1. Canadian traveller's API indicates they checked 5 bags
2. Traveller submits eDeclaration and indicates 5 bags
3. Traveller only picks up 3 bags at baggage carousel
4. Traveller goes to airline to report 2 lost bags (fills e-A23 form)
5. Traveller heads to Egress
6. Face Recognition workflow links the traveller to number of bags
7. Information displayed on screen for an officer for verification (could be non-BSO)
8. Send traveller to Egress Rover.
9. OK

Scenario #3 – Time delay:
1. Foreign national granted eTA
2. Traveller generates RBR
3. Traveller checks-in (Trip Record starts)
4. eTA Predictive Analytics hit
5. Wheels Up (Trip Record, Risk Assessment products)
6. eDeclaration completed on plane
7. Arrival
8. Traveller submits eDeclaration (validate RBR)
9.
10.
11. (geo-locate by wifi)
12. Time analysis triggers
13. ,
14. Rover dispatched to intercept traveller in Arrival hall
15. Rover interviews traveller
16. Primary Kiosk
17. Egress

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Scenario #4 – Passport Renewal:

1. Canadian traveller get mobile app for entering Canada
2. Traveller creates "My Profile" (RBR)
3. App indicates to the traveller that their passport is close to expire date.
4. Traveller poses a question to CBSA on the mobile app
5. CBSA answers the question (provides "Did You Know?" trivia)
6. Traveller buys a ticket
7. Allow trip history to be viewed (passport stamp)
8. Check in (e-check in)
9. Get passport info – flag passport expiry date to traveller
10. In flight
    a. Traveller completes eDec
    b. Traveller buys duty free items
    c. Traveller updates eDec
11. Arrival
    a. Traveller submits eDec
    b. App reminds traveller that passport is about to expire
    c. App invites traveller to start passport renewal process on mobile
12. Primary Kiosk

Possible Missing Stories:

Only four baseline storyboards were created during the initial design workshop. It may be of interest to develop stories related to:

- Back office (CBSA Operations) in terms of dynamically changing the workflow based on Ops
- flags to Secondary needed to be tested (Inadmissible Person, Suspected Smuggling)
- Groups of travellers
    o associated travellers
    o disease

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Prototype Partner Responsibilities

To ensure the success of the project, each partner is responsible for a specific aspect of the prototype. In some cases, there will be shared responsibilities and ongoing/close collaboration must exist in order to reduce the duplication of work. The responsibilities are listed below:

- o IRCC
  - o Manage Project (Project Lead)
  - o Predictive Analytics on ETA

- o CBSA
  - o Exercise Coordination
  - o Exercise site fit-up
  - o Operational apps (UI)
    - Kiosks → outsource to Identos
    - Rover and Egress → BASD
    - NTC – Blackbox
    - Int app
    - Spec serv app

- o WorldReach
  - o Host platform,
  - o Traveller mobile app(s)
  - o Mobile data collected from traveller
  - o Visionbox dashboard

- o Entrust
  - o The "orchestrator" – policy based risk assessment and workflow
  - o Supporting databases for orchestrator
  - o Trip records

- o University of Ottawa
  - o RBR
  - o Predictive Analytics for CBSA (general → look for "doubt")

- o Face4
  - o Face recognition workflow,
  - o Manage traveller flow (execute with integrity check),
  - o Visionbox dashboard.

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Next Steps:

The initial design workshop provides a foundation upon which the exercises will be built. The following next steps will evolve the project towards executing the testing exercises:

1) Review this report across all project partners and agree on the foundational design
2) Develop the narrative around the four baseline scenario stories to clarify the objectives of the exercises.
3) Determine the policy questions and policy maps needed by the Risk Assessment/Workflow Orchestrator that will bring the four baseline scenarios to life in the upcoming exercises.
4) Plan and execute the first exercise in order to flush out the elements of interest within the Chain of Trust concepts, and the details related to the level of development required for integration and testing of the elements.
5) Develop measurements that will articulate the level to which the elements of interest in the chain of trust project work or don't work.
6) Establish the various mini design teams and the rhythm of work required to execute the exercises

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Annex 1: List of project resources who participated in the workshop:

Name	Organization
Barrett, Naomi	Canada Border Services Agency
Bissessar, David	Canada Border Services Agency
Galton, Eric	Canada Border Services Agency
Léonard, Marc (Lab)	Canada Border Services Agency
Mungham, Tony	Canada Border Services Agency
Wong, Jonathan	Canada Border Services Agency
Anderson, Jarek	Canada Border Services Agency
Miovski, Vasil	Canada Border Services Agency
Sanderson, Paul	Canada Border Services Agency
Tolmie, Michael	Canada Border Services Agency
El-taki, Moe	Canada Border Services Agency
Haymes.Michael	Immigration Refugee and Citizenship Canada
	University of Ottawa
	University of Ottawa
	University of Ottawa
	Face4 Systems Inc.
	Face4 Systems Inc.
	WorldReach
	WorldReach
	WorldReach
	WorldReach
	WorldReach
	Entrust
	Entrust
	Entrust
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Chain of Trust (CoT)
Prototype 1 - Outcomes and Notes

Date: August 8th, 2017   Reference: CoT20170808

Prototype 1:

The Chain of Trust project held "Prototype 1" at the Face4 Systems Inc. office from July 10th to 12th, 2017. During the first two days, the project team ran four body-storming exercises for each of the pre-determined "Scenario Stories" in order to refine all the necessary data elements and determine the *movement* of these data elements between the various actors/systems. These exercises were low fidelity and paper-based in order to reflect our project principle of design thinking and rapid prototyping. Day three of Prototype 1 was reserved for discussing outcomes from the first two days, identifying the individual pieces of the system, determining the microteam leaders, determining the target scope for Prototype 2, and deciding how often the whole Design Team will be meeting.

Going forward, the microteam leaders were tasked with assembling their teams, meeting with them to decide what they can (and *can't*) deliver for Prototype 2 in September 2017, and building those pieces in time for Prototype 2 (whether real or simulated).

It was also decided that the full project team will meet every two weeks (Thursday afternoons) for a Design Team meeting. The meetings will take place at the CBSA Lab (either the Colonnade or Bentley office) and project team members can attend in person or use the teleconference system to call in. The microteams will report on their progress at each of these meetings. The first Design Team meeting is set for July 25th, 2017.

This Prototype 1 report:

The following document outlines some of the notes, questions, concerns, and comments from Prototype 1 as recorded by Eric Galton (CBSA Lab) and   (WorldReach). These can be considered as "Critical Project Drivers" as we continue through the rest of the project.

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s.16(2)

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Scenario notes

Below you will find notes that were written as the project team body-stormed the four scenario stories. The notes from all four scenarios have been compiled and structured according to a rough timeline.

Zone: Traveller Downloads, Sets-Up, and Uses the CBSA Mobile App:

Mobile App (MyTravel) notes:

- Need name and email address to start account. Some discussion about whether Passport # or other info required at this time. Traveller may be resistant to provide more. What would be incentive to do so?
-

- App will have a CBSA chat session option, or simply an FAQ section which would allow for text search & retrieval of content to match query (FAQ should allow off line usage).
- Category based content to help find information, will also allow off line usage.
- Traveller should always have an indication of what events they still need to do (e.g. get an ETA, present at kiosk for payments, etc...).
- App will allow traveller to request their travel history. CBSA will be able to find this information in passage records (CBSA Programs will address method of look-up). CBSA can then send list as PDF (would require an email out →adding scope? this is not a commitment for the project, but a good stretch goal.)
- Could be valuable to get voluntary provision/approval from traveller to share PNR data collected by reservation systems – to provide to CBSA. Incentive for traveller – expedited processing on arrival. If available provide to Orchestrator.
- NOTE: CBSA system holds RBR not on the phone, will be in cloud site.

Zone: Traveller ETA application:

IRCC P.A. notes:

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- IRCC will also pass Orchestrator the date of issue of ETA – important to know.
- IRCC PA is never missing a score for an ETA.

Zone: Traveller Check-In:

Traveller Check-In notes:
- At check in – additional info obtained from taking an OCR of passport biopage would benefit the traveller – ensures accurate data, no need to manually enter.
- User responsibility to take this step – no prompt by system (assumed for now).
- Later data may be pushed to traveller.

VisionBox notes:
- Info for VisionBox Orchestra – (from PRN, API, & from Orchestrator workflow)
  - Number of Canadians and non-Canadians on flight;
  -
  - Timing of flight arrivals (from Airport Authorities, other online sources).
- CBSA Back office can use this info for operational purposes (assign BSOs to needed areas).

Orchestrator workflow:
- Once API data available, Orchestrator starts Trip Record.
- Traveller mobile app will get updates from Orchestrator workflow – push/pull, integrated service bus, Other (means to be determined in micro groups).
- Mobile app will interpret status from Orchestrator workflow & present message to the traveller.
- Traveller state control – is separate from Orchestrator workflow – but is it handled by a different system? To be determined.

CBSA Predictive Analytics notes:

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- 2 themes that PA will fire on (travellers who are not the Criminal element):

- Will likely have 2 scores on 2 characteristics to feed to trip record – may be useful to keep these scores here, history of scores.
- Won't necessarily have all data – may be in situation where need more data from traveller.

Zone: Traveller In Flight:

Traveller in Flight notes:
- Requesting traveller to take RBR photo prior to landing may be an issue – if people try to take it on the plane it could be a distorted photo (taken too close); non–uniform lighting also can lead to poor quality. Will be some check on quality but may not be sufficient. Need to consider instructions for traveller & alternate time for photo to be done. Poor photo may require directing traveller to kiosk for second verification photo. This would be an event to Orchestrator -workflow.
- e-Declaration can be completed in transit (on airplane) but can't be submitted until on Canada soil. App needs to 'save' data.

Zone: Traveller De-plane:

Traveller notes:
- E-Declaration barcode should only contain machine readable info from e-Declaration nothing more.
- If a traveller doesn't have an RBR match once in primary will require going to Primary kiosk.
- No map or arrows in the Mobile App for now (we have removed all references to static or interactive maps/GPS from the scenario stories.)

Orchestrator notes:
- Want to set a timer when plane lands to track time to Primary.
- Some question around what triggers this timer (indication from Airport Authority that plane down, first passengers start doing their Primary RBR confirmation, other?).

- What is passed to Mobile command – previous selfie or kiosk photo from passage record, other info from API (enough to identify the person).

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- Mobile command broadcast via radio to all officers to look for traveller, BSO who finds traveller takes this alert & actions it.
- As alert for traveller cleared by BSO (eg. Found traveller in arrival hall, no issue), for the traveller, the CBSA PA will be re-run for the traveller, Orchestrator reruns overall referral rules.
- Individual alerts have colour   not cumulative.
- Overall referral is either

Zone: Primary and Intermediate:

Primary Kiosk notes:
- A lot of discussion on whether it is essential that the first time the CoT traveller goes through system must present at kiosk. Not taking advantage of ways that can authenticate traveller remotely in this approach. Needs further discussion.
- Looking for reasons why public will buy into this process – if have to use kiosk where is benefit?
- Kiosks need to be able to read the e-Passport.

Facial recognition notes:
- Facial recognition prepares facial template from kiosk photo or selfie & photo at enrollment at their gate(?)
- Some question around how Facial recognition gets the kiosk photo or selfie from Orchestrator (push, pull, service bus).
- Each time a traveller enrolls at Facial recognition – event sent to Orchestrator & becomes part of trip record.
- If something has not allowed normal processing (e.g. person entered zone but didn't come out), then facial recognition will require a reset of system.
- Reset will go to Orchestrator workflow so next event message can be sent.

Orchestrator notes:
- Trip record will contain selfie taken at primary used to verify RBR.

Mobile Command Dispatch System notes:
- Kiosks must be able to send message to Mobile Command (e.g. for failed RBR).
- Any dispatch pushed out to BSO from back office – e.g. alarm – to be on outlook for certain traveller. Dispatch may be to all BSOs, one who picks it up need to notify them have it, so task can be closed. If not picked up, back office can escalate.

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- Communication by radio with back office won't be going away – this dispatch supplements it doesn't replace it.

BSO wrist-mounted mobile device notes:
- Some questions about what information they will need access to...
- BSOs should know what is pending for the traveller – what do they still need to do.
- BSO should be able to take ownership of broadcast alert (once done, this will need to trigger an event in Orchestrator workflow to update the trip record).
- BSO should be able to have either selfie from RBR verification or previous kiosk photo as well as other traveller data.
- BSOs may want to have access to full list of incoming flight (# reds, greens) or should back office only have this?

Time Delay scenario notes:
- If there is a time delay, the enforcement alert will trigger the re-run of the CBSA predictive analytics to gather the up-to-date information of the risk score.
- To clear the time delay, questions will need to be asked by the BSO. If the answers satisfy the officer, the agent should also be able to check the risk score from the IRCC predictive analytics, in this present scenario, why the score is

Zone: Traveller in Baggage Area:

Missing Bag notes:
-

Zone: Egress:

Orchestrator notes:
- Orchestrator never closes a   trip.
- Must allow for manual override of a   status to become   – based on behaviour etc.

Facial Recognition notes:
- If no enrollment of face has occurred prior to egress will allow enrollment at this point. This sends message to Orchestrator which confirms status
- Facial recognition – once confirm traveller – will trigger closing of the trip record.

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- Facial recognition will not keep photos – clean up (every X amount of time).

Zone: Passport Renewal:

Passport renewal notes:
- In order to be able to notify traveller their passport is about to expire need to have passport info – therefore need to get passport info from them at some point (this is a good reason for asking for passport scan earlier than at check-in).
- The traveller should be able to dismiss the notification in the Mobile App if they instead decide to pursue the renewal at a passport office.
- When they get their new passport, traveller will have to update profile in My CBSA.
- Mobile App will not notify traveller of automatic renewal, instead traveller will get "in process" notification.

Concerns/questions that need to be addressed:

Below are some important concerns and questions that were noted during Prototype 1. We will continue to address these issues as we proceed through the project lifecycle.

1. Checked luggage vs. Carry Ons
   a. How to differentiate checked luggage from carry-on bags at Egress? (Some carry-on bags are quite large – How would the Egress security officer know which bags to count?)

2. Is there a better way to get PNR information?
   a. Can we question the traveller on their mobile phone → OK to share?
   b. If yes, display what is to be shared.
      i. Validate/Approve

3. Concern with RBR PIN
   a. Concern that travellers might not like it having to remember a PIN.

4.

5. What information does a BSO need to know to effectively do their job?
   a. What needs to go on the wrist-mounted device?

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6. The difference between Primary and Intermediate kiosk zones
   a. Based on the scenarios we ran, one seemed to focus on collecting identity and e-Declarations, and one for admin tasks. We are not sure if those are different from the point of view of the traveller.
   b. Is there a functional need to have the two zones? Can all flags be dealt with in the same zone? There could be less traveller confusion by simplifying this into one zone.

7. Multiple passports
   a. How does IRCC/Passport Canada want us to handle the issue of multiple passports during the passport transition phase? (New passport has been approved and is valid but the traveller hasn't picked it up yet.) What is their process?

8. Events & Timers
   a. All events must be captured in the workflow.
   b. There was a discussion on the timer for primary. The Trip Assessment will have a built-in configuration file which will host an overall time it will take for a traveller to walk from the gate to the primary zone. The timer will be triggered by the first person from that flight who cleared primary. Is this still a viable concept?

Items that were decided during Prototype 1:

Here below is a list of decisions/resolutions that were noted during the course of Prototype 1.

1. System communication
   a. Systems communication will be based on:
      o Structure
      o Events.

2. Common data elements:
   a. It has been identified that the following data elements are common during the traveller continuum:
      o Trip Record
      o Seed data to drive story
      o My Travel (+RBR)
      o GCMS
      o eTA
      o Passage Record.

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3. Codes (programming)
   a. Note: Don't focus on reusable codes, functions, classes, components. The focus is on the functionality, not efficiency, for Prototype 2.

4. Overall risk score within the context of all risk scores
   a. It is understood that the overall risk score is an amalgamation of all the other risk scores.
   This is described in the example below:

   b. All global risk scores (IRCC P.A. and CBSA P.A.) are to be stored in the Trip Record and the evolution history is to be kept during the traveller's continuum.

5. CBSA "My Profile"
   a. The CBSA My Profile contains the following basic data elements:
      o Name
      o Email Address
      o Passport number or OCR the passport page
      o Photo (to be confirmed)
      o Occupation (to be confirmed)
      o Employer (to be confirmed)

6. Primary Kiosk
   a. In the context of the prototype, the primary kiosk (which will share a lot of base code from the Mobile App), will be used to:
      o Take initial photo of 1st time Chain of Trust traveller (reliable photo conditions/ no distortions)
      o Validate RBR codes
      o Scan traveller's e-passport
      o Review e-Declaration (if needed)
      o Use photo for enrolment into Face4 workflow system (?)

7. Orchestrator (Trip Assessment)
   a. The Orchestrator (Trip Assessment) will be used to:
      o Publish the state change
      o Publish the next state
      o Provide a subscription mechanism to the traveller and CBSA for current and future traveller's state

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b. The logic of the Trip Assessment should be able to be adjusted as per Port of Entry (POE) required staff and overall capacity.

8. Wrist-Mounted Mobile Device
   a. The Egress and Secondary activities and actions will be managed via the BSOs wrist-mounted mobile device which will be capable of changing/updating a traveller's Trip Record.

9. Data Stores
   a. Two data stores that were missing in the original conceptual Technology Block Diagram have been identified and added to the overall architecture:
      o CBSA "My Profile"
      o CBSA "Mobile Command Dispatch System" (which will use a zone-based notification in the message envelope to target specific group of BSOs via their wrist-mounted device)

10. The Trip Record
   a. The Trip Record will hold all information about the traveller during the continuum. It will be read and updated by the Trip Assessment engine, though other systems may also need access to some key data (Ex: Facial Flow Control for Egress).
   b. The Trip Records starts upon receipt of API data.

11. IRCC Predictive Analytics
   a. The predictive analytics engine will need to expose, upon request, the following data elements:

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b. These data elements will be stored in the Trip Record.

Things we need to do:

1. Map of all events
    a. In order to achieve a perfect inter-system communication in the event's flow, it is recommended to draft a map of all the events.
2. RBR
    a. David will look at some suggestions/ideas for a "second hunch" generator (something that could change over time).

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Annex Diagrams

In the next four pages please find the following diagrams:

- o Annex 1: Chain of Trust Team Structure
- o Annex 2: Chain of Trust – Individual Pieces & their respective functionality (Microteam leaders listed in Red)
- o Annex 3: Chain of Trust – Architecture Diagram and Data Flow
- o Annex 4: Chain of Trust – Communications

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Annex 1: Chain of Trust Team Structure

PROJECT MANAGEMENT

IRCC

DESIGN TEAM

ALL

| Micro Team | Micro Team | Micro Team | Micro Team | Micro Team |
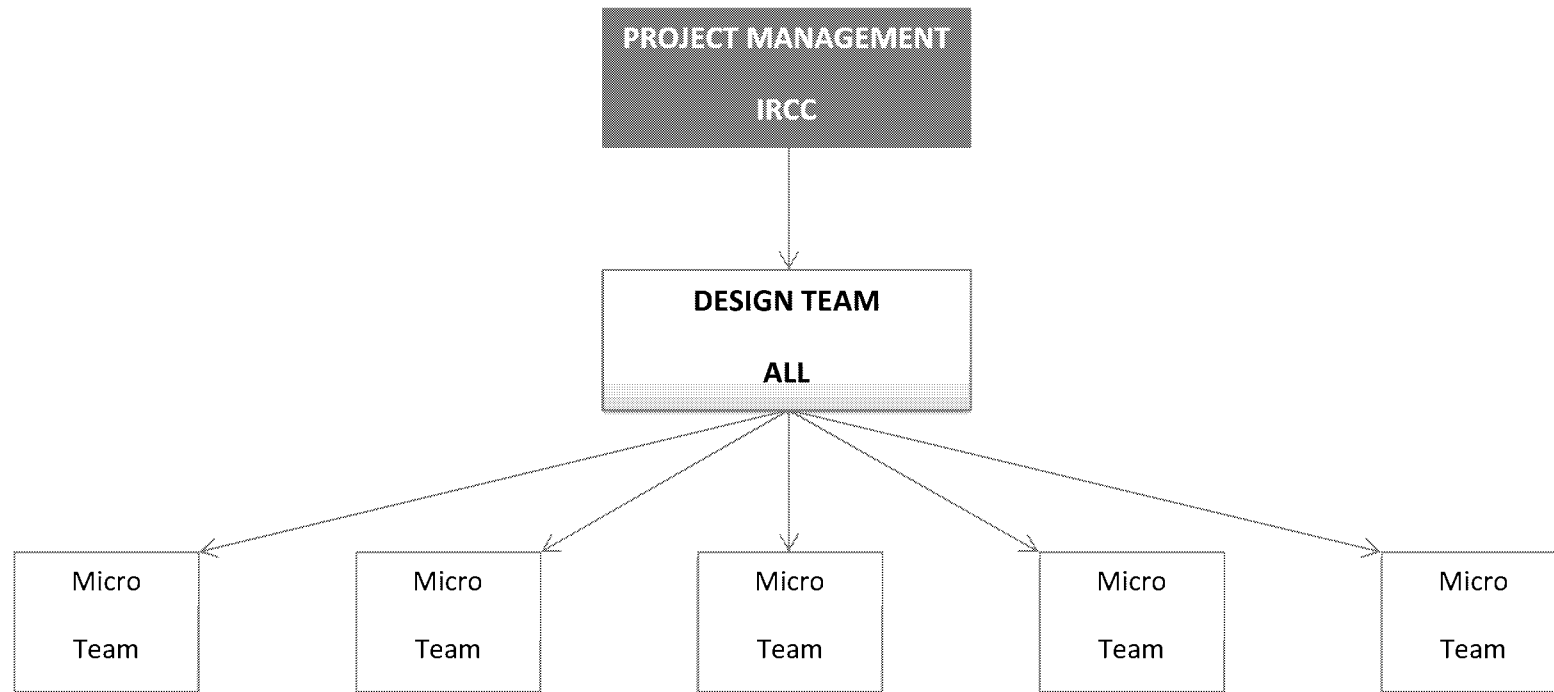
For the project, there are common components that are represented by the following persons:

Entrust:	WorldReach:	University of Ottawa:
University of Ottawa:	**University of Ottawa**:	**CBSA**: Sopheap Ker
CBSA: Colin Thompson	**CBSA**: Marc Leonard	**CBSA**: Eric Galton

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Chain of Trust (CoT)
Exercise 2 - Outcomes and Notes

Date: October 10th, 2017   Reference: CoT20171011

Exercise 2 Summary Report:

The Chain of Trust project held its Exercise 2 at the CBSA Science and Engineering Facility from September 19th to 21st, 2017. The exercise was designed to assess the system design by walking "travellers" through a simulated operational scenario.

On Day 1 of the exercise, volunteer actors played the roles in a story (traveller, roving BSO, egress officer) and moved throughout our simulated "airport" while interacting with the various systems of the Chain of Trust project. These walk-throughs allowed the project partners (and micro-teams) to assess the functionality of their individual pieces, learn more about the system's communication needs (risk assessment/information flow), and see the traveller flow in action. Overall technical progress on the project was more advanced than had been anticipated. Many of the communication links with the orchestrator were already operational, despite belief that most would require manual simulation at this stage.

On Day 2 of the exercise, a smaller group of project partners worked to refine certain data communications elements based on findings from the previous day. On Day 3, the whole project team assembled to review the previous two days of work: identifying the elements that worked, the elements that did not, and fleshing out the "next steps" for each micro-team. The final portion of the day was devoted to planning for Exercise 3.

Various additional observers from the CBSA and IRCC attended the prototype exercise to provide useful insight from their own domain expertise (such as a team from CBSA Programs). On the final day of the exercise, a small delegation from IRCC and Transport Canada were also provided with a walk-through of the early prototype and an overview of the project.

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The Site

The CBSA Science and Engineering Directorate has secured a project space at 79 Bentley Avenue in Ottawa. This space will house the prototype exercises for the duration of the project. The project space has been configured to simulate an airport using both metal truss and stanchions to delineate various "zones" such as an Arrivals hall, Intermediate area, baggage carousel, and egress zone. Additional zones were also added to simulate the traveller's "pre-departure period" (applying for eTA, buying tickets to Canada, in flight, etc.) as well as an area to simulate CBSA back office functions at the airport.

Planning and Preliminaries

In preparation for the Exercise 2, the Chain of Trust partners established micro-teams to advance specific thematic elements of the prototype. Each micro-team participated in weekly conference calls to discuss technical development, outstanding issues/challenges, and determine next steps. Larger 'Design Team' meetings were convened on a bi-weekly basis, which focussed on the overall progress, logistics, issues, and project management. Additionally, in the weeks leading up to the exercise, the project space at 79 Bentley was made available to the project partners for equipment setup and testing of their communication links with the orchestrator system.

Exercise 2

The Chain of Trust project team has developed several storylines (Annex B) in order to simulate various potential traveller/BSO/system experiences. Exercise 2 focussed exclusively on the simulation of Scenario #3 which showcases the continuous risk assessment of a foreign visitor arriving in Canada and proceeding through the travel continuum. This particular scenario was chosen because it would allow for assessment of all major sub-components of the project. Over the three day exercise, volunteer actors played the role of the traveller, moving from their initial travel planning (applying for an electronic travel authorization, check-in, etc.), all the way through to their egress from the Canadian

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airport. This 'scenario' approach allowed for a practical assessment of both the system's design and the user's experience as they interacted with the technology.

To protect privacy and sensitive information, no real passports or personal phones were used in Exercise 2. Instead, the project team developed simulated traveller data, used specimen passports, and purchased mobile devices that will be used exclusively for Chain of Trust. Additionally, sensitive information relating to CBSA and IRCC operations was excluded from the scope of the exercise.

Exercise 2 was the second of four exercises planned under the Chain of Trust Project, each progressively increasing in the level of technical fidelity. Exercise 1 was undertaken on July 10-12, 2017, and focussed on fleshing out the design and flow of the Chain of Trust project scenarios. Exercises 3 and 4 will examine further refinement on the progress established in exercise 2, finalizing remaining communication components, and expanding the design assessment to a larger number of operational scenarios.

The Scenario #3 storyline is described below:

Scenario #3 – Time delay triggered (International traveler)

Marie Bennet is a French citizen who completed her undergraduate degree at the University of British Columbia on an approved student permit 10 years ago. Marie is now planning a trip from Paris, France, back to Vancouver, BC to visit some friends from university. Marie downloads the CBSA app on her mobile phone and creates her CBSA "My Profile" by following the instructions on the screen. She scans her passport, enters her personal information, and takes 7 selfie pictures of herself in order to generate her initial RBR code. As a foreign national from a visa-exempt country, Marie requires an eTA to visit Canada. She uses the app to complete her eTA application, pay the IRCC transaction fee, and send her application to IRCC for review.

Marie's eTA is approved within seconds and she receives notification of this approval on her mobile phone.

Marie buys her tickets to Canada. Two days later, she arrives at Charles de Gaulle airport in Paris, France and checks-in for her flight. At this time the CBSA starts Marie's "Trip Record" in the system. On the plane ride to Vancouver, Marie drafts her e-Declaration using the app on her mobile phone and confirms her declaration using her facial biometric (she takes a selfie on the plane).

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Marie disembarks the plane in Vancouver and sees that she has wi-fi now available, so she opens her CBSA app and submits her e-Declaration. The app then notifies Marie that, as a new enrolee in the Chain of Trust program, she will need to present herself at a Primary kiosk in the Arrival hall for "photo validation."
Marie makes her way to the Arrival Hall.

However, an hour passes by and the CBSA Risk Assessment system notes that "Marie Bennet" still hasn't presented herself at a Primary kiosk, nor has the Face Recognition flow control system captured her moving anywhere past the Arrival hall.

Andria Bingley, a CBSA Mobile Enforcement Officer, finds Marie Bennet sitting in the Arrival area. Andria _____ using her wrist-mounted mobile device, then approaches Marie. It turns out that Marie's mobile phone had been about to run out of power, so she had plugged her phone into a free outlet on the wall and was waiting for it to re-charge. After a lengthy interview, Andria determines that she sees no reason to keep Marie's _____ so she uses her wrist-mounted mobile device to downgrade Marie to _____ in the system (since Marie still needs to complete her photo validation at a Primary kiosk). Andria then directs Marie to present herself at a Primary kiosk as soon as possible, and then goes back to her roving duties.

Marie picks up her mobile phone and goes to kiosk #11 in the Primary zone. Kiosk #11 takes a photo of Marie and validates her RBR codes. Marie is now made _____ n the system and directed to the baggage carousel in the Intermediate zone. Marie goes to the baggage carousel and easily picks up her bag. Marie is then directed by the app to enter one of the Egress lanes.   In Egress lane #4, the Face Recognition flow control system recognizes "Marie Bennet" and shows that she is a _____ traveller with "one" piece of luggage. Johnathon Darcy, the security officer at Egress lane #4, sees this information displayed on a screen and confirms that Marie does indeed have only one bag. Jonathan lets Marie proceed to the exit of the Egress zone and leave the airport.

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Progress, Challenges, and Next Steps

To support the development of this report, each micro-team leader was asked to provide their notes from Exercise 2. These notes listed the elements that worked, those that did not, and outlined the remaining work that needs to be done. Summaries of these notes are provided below:

> **TRAVELLER MOBILE APP ("MY TRAVEL" APP):**

All steps required to execute scenario 3 on the mobile device were completed and available for the exercise. For the simulation, a 'wizard' interface was used to manually trigger the traveler's next steps/available actions in the mobile app (RBR, eTA, e – Declaration).

Next steps for the app will include:

- improving traveler notifications to make new messages more apparent to travelers,
- an examination of some of the terminology used within the text of the app,
- completion of the integration between the MyTravel App and the Orchestrator system, as well as between the MyTravel App and the Renewable Biometric Reference (RBR) Service. It is anticipated that this will be functional for Exercise 3.
- modification of the MyTravel app will also be made to allow for more than one trip to be sequentially initiated and completed.
- Finally, next steps will include the design of the passport renewal component for Canadians using the MyTravel app.

> **KIOSKS**

Functionality of the 'Primary' kiosk was ready for Exercise 2 (including RBR validation and integration with a simulated RBR server). Furthermore, an enrollment function was developed in order to capture a photo of each actor and substitute it for the specimen passport photo in the MyTravel server. This allowed the project team simulate the scenario with real specimen passports.

Feedback on the Primary kiosk's processes indicated that the system was very simple and fast to use, though some usability elements could be addressed in future iterations (responsiveness of buttons, passport reader location, etc.). There was discussion of looking at acquiring other models of tablets which likely would not have NFC & therefore require use of an external NFC reader *(NOTE: further research indicates that this will not be possible at this time due to a software issue – we have decided to forego this idea).*

Next steps for the kiosks will include:

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- developing the 'Intermediate' kiosk for the administrative task of paying fees;
- creating a check-in function to simulate what happens at airline check-in for beginning of the trip record.

➢ ORCHESTRATOR

By the end Exercise 2, many of the technology elements were communicating with the orchestrator system, though several elements of the prototype still required simulation through manual triggering (use of a "wizard").

Next steps for the Orchestrator will include:

- align data fields,
- incorporate traveler photos,
- and add additional policies.

It is anticipated that the system will be 100% rules-driven for Exercise #3 in December.

➢ RENEWABLE BIOMETRIC REFERENCE (RBR)

Next steps for the RBR elements include:
- reformat some of the photos captured in the exercise,
- load the RBR code to the WorldReach server.
- The U of O team will also further examine the system's robustness in dealing with variability of the photo quality, cameras used, etc.

➢ IRCC PREDICTIVE ANALYTICS

A realistic risk scoring system (built using simulated traveler data) developed under CSSP was demonstrated separately from the direct traveller flow using an IRCC laptop. This was done intentionally to avoid exposing the underlying code and scoring criteria.

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Next steps for IRCC Predictive Analytics include:

- improve the risk scoring modeling to capture additional types of risk.

➢ CBSA PREDICTIVE ANALYTICS

CBSA Predictive Analytics was able to establish communications with the Orchestrator for the purposes of scoring. A client program was developed enabling the system to listen and parse the broadcast from the Orchestrator, query the server database for trip record, evaluate the risk score and send the result back to Orchestrator.

Realistic data was simulated based on input from the CBSA and external sources such as Statistics Canada. Three distinct scoring models were built to assess risk of travelers with: (1) undeclared goods; (2) undeclared currency, and (3) intention to overstay. The models were designed to process the scoring at two time points in the traveller continuum –

Next steps for CBSA Predictive Analytics include:
- seeding the "backstory" for testing the CBSA Predictive Analysis Engine
- moving the code from a laptop to a cloud environment
- optimizing the communication with the Orchestrator
- and continuing to tune and add complexity to the model to improve performance.

➢ FACE RECOGNITION/TRAVELER FLOW

Face4 computers and monitors were installed and connected to the CBSA-installed network and sensors. Face4 developed and installed face flow software and demonstrated the system using software buttons to simulate optical sensors. The focus was on demonstrating very fast capture, match, and display. In some cases, the camera was capturing faces of people outside of the traffic lane. There was some discussion about possibly using screens between egress lanes to prevent this.

Next steps for Face Recognition/Traveler Flow will include:

- integrating with the sensors and establishing communications with the Orchestrator.

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- Additional operational input will also be collected to deal with exceptions, configure for multiple lanes/entrance lanes, examine usability/signage, and determine needs for the officer-facing display.
- Face4 will continue to test in CBSA facility prior to Exercise 3.

➢ CBSA MOBILE ENFORCEMENT APP AND DISPATCH SYSTEM

For Exercise 2, the Mobile Dispatcher web service was able to establish communications with the Orchestrator queue, including querying for a traveler's record. The system was able to send and receive messages to/from the Mobile Enforcement app via Firebase Cloud Messaging (FCM).

Next steps for the CBSA Mobile Enforcement App and Dispatch System will include:

- further development of the mobile enforcement scenarios,
- improve the user interface,
- and work out expected Traveller State messaging for the Orchestrator.
- For the next prototype exercise, it is planned to have the mobile dispatch web service deployed to the server, have a basic functional version of the mobile dispatch and mobile enforcement app.

OTHER FINDINGS (MISCELLANEOUS)

- The process of taking multiple selfie and kiosk photos throughout the travel continuum (for identity verification) was perceived as rather onerous. Further discussions to come.
- The use of mobile apps to undertake some activities (e.g., e-311 submission, passport scans) rests on an assumption of widespread wi-fi availability to travellers.
- There was some discussion around potentially moving the face recognition to an earlier stage in the travel process.
- There was a comment that it may be important to separate messages by zone or limit the number of messages seen by a particular BSO to only the most pressing.
- Additionally, it was noted that the system could include a feedback mechanism for providing Border Services Officers with information on the outcomes of their referrals to secondary.
- Volunteers felt that the mobile traveller app was very intuitive, with some minor suggestions for improvement (e.g., improved home screen navigation and more user-friendly terminology in the text).

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NEXT STEPS:

- Exercise #3 will occur in December 2017 and will focus on all remaining scenarios, including two enforcement scenarios currently under development by the CBSA.
- Project Partners will continue to undertake the regular bi-weekly Design Team meetings in the lead-up to the next prototype exercise.
- Micro-team leads and project partners were advised to have their list of next steps underway for the following Design Team meeting, scheduled for October 5th.

Annex Diagrams

In the next four pages please find the following diagrams:

o   Annex 1: Chain of Trust – Individual Pieces & their respective functionality (Micro-team leaders listed in Red)
o   Annex 2: Chain of Trust – Exercise Scenarios
o   Annex 3: Chain of Trust – Communications

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ANNEX 1: Chain of Trust – Individual Pieces & their respective functionality (Microteam leader listed in Red)

Orchestrator	Mobile Device (traveller)	IRCC Predictive Analytics	RBR
• Policies & details: • Linkage between event and policies (mapping) • Events to publish • Passage data update **Microteam:** Entrust:	• My Travel (+RBR) • eTA • e-Declaration **Microteam:** WorldReach: Identos hardware	• WR-eTA • GCMS Future: Feedback from CoT **Microteam:** IRCC: Mike WorldReach:	•Service core •Mobile device (My Travel) •Kiosk **Microteam:** U of Ottawa: CBSA Lab: WorldReach

CBSA Predictive Analytics
 	
• Orchestrator events
• Orchestrator data
• Other data (passage records)
• IRCC Predictive Analytics
 	
Microteam:
U of Ottawa:
CBSA Lab: David
IRCC: Mike
	Kiosk Primary
	
	• E-Declaration
	• RBR
	• Photo
	• Passport read
	• Payment
	
	Microteam:
	CBSA BASD: Colin
	WorldReach:
	CBSA Lab: David
		Flow Control
		
		• Events from Orchestrator
		  ➢ Enrollment
		  ➢ Indicate FR needed (required)
		  ➢ Indicate FR happened
		• Time response is a concern
		• Egress display
		
		Microteam:
		Face 4:
		CBSA Lab: David
			Mobile Enforcement App (MWMD)
			
			• Trip
			• Notification (dispatch)
			• Updates the trip record
			
			Microteam:
			CBSA BASD: Sopheap

Kiosk Intermediate • Payment **Microteam:** CBSA BASD: Colin WorldReach: CBSA Lab: David			

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Annex 2 – Exercise Scenarios

*Note that these scenarios are living documents subject to further refinement as the project progresses to ensure an operationally realistic scenario. Several additional scenarios, focussing on CBSA enforcement situations will also be developed for future exercises. *See Main text of this report for the description of exercise 3.*

Scenario #1 – Broken RBR (Canadian traveler)

1. Canadian traveler drafts his e-Declaration on the airplane
   a. CBSA POE Administrator sees that extra flights will be arriving on the dashboard
   b. CBSA POE Administrator notifies CBSA Mobile Enforcement Command of extra flights
2. Traveler arrives and Submits e-Declaration
3. Overlimit → traveler directed to Intermediate
4. Traveler tries to pay fees at intermediate kiosk, but the RBR fails –
5. Kiosk notifies the Enforcement Officer
6. Enforcement Officer goes to kiosk, talks to traveler, checks face,

The STORY:

Jim Dayne is a Canadian citizen who travels a lot and has re-entered Canada numerous times using the CBSA app on his mobile phone. He generated his initial RBR over 2 years ago, and therefore the CBSA system has established a level of trust in Jim and rarely requires him to validate his RBR at a Primary kiosk.

Jim is returning home to Montreal, Quebec after a week-long vacation in El Paso, Texas. On the plane ride back to Montreal he drafts his e-Declaration using the app on his mobile phone and then confirms his declaration using his facial biometric.

Daniel Tarth is the CBSA POE Administrator at Pierre Eliot Trudeau International airport. Early in the morning, Daniel looks at his operations dashboard (which provides information from the airport authority, iAPI, and other sources) and he sees that there are 20 incoming flights scheduled to arrive later in the afternoon (including Jim Dayne's flight). Understanding that there will soon be an influx of travellers, Daniel tells Hannah Clegane at CBSA Mobile Enforcement Command of the extra incoming flights,

Once the plane has arrived at the airport, Jim grabs his carry-on luggage, disembarks, and starts walking towards the Primary zone. While walking with the other travellers, Jim submits his e-Declaration on his mobile phone. The CBSA system compares Jim's e-Declaration RBR with his original "My Profile" RBR and has no problem validating Jim's e-Declaration identity. The CBSA app then notifies Jim that he will have to pay fees for the items he is bringing back to Canada at a kiosk in the Intermediate zone.

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Jim goes to kiosk #13 in the Intermediate area to pay his fees. The kiosk asks Jim to present his passport, so he follows the on-screen instructions and the kiosk scans the MRZ chip on his passport. The kiosk then tells Jim to stand still for an RBR validation photo to confirm his identity. Jim smiles as the photo is taken and waits for further instruction. However, the CBSA system is unable to validate the RBR photo taken at the kiosk – it seems that the new RBR code is failing to match up with Jim's "My Profile" RBR code. Three things happen at this time: (1) Jim   (2) kiosk #13 notifies Jim that there is a problem with confirming his identity and tells him to stay at the kiosk while a customs officer comes to talk to him, and (3) the system sends an alert to a nearby CBSA Mobile Enforcement Officer requesting help at kiosk # 13.

Brendan Martell, a CBSA Mobile Enforcement Officer stationed in the Intermediate zone, receives the notification from kiosk #13 on his wrist-mounted mobile device. Brendan takes ownership of the alert and then heads towards the kiosk.

Brendan approaches Jim and explains why he is there. Brendan interviews Jim over the next few minutes and soon realizes that Jim is indeed who he says he is. Brendan decides that he sees no reason to maintain Jim's threat level, so he downgrades Jim Dayne   in the system. Brendan uses his mobile device to validate Jim's face in the system and overrides the match error in the system. Brendan tells Jim he can now pays his fees.

Jim pays his fees (and is now made   in the system).

Jim goes to the baggage carousel, retrieves his suitcase, and proceeds to the Egress zone. As he enters Egress lane #2, the Face Recognition flow control system identifies "Jim Dayne" and displays that he is a   who should have "one" piece of luggage with him.

Lydia Bronn, the security officer monitoring Egress lane #2, sees the displayed information and then looks over to confirm that Jim Dayne does indeed have only one bag. Lydia allows Jim to proceed forward, exit the Egress zone, and enter Canada.

Scenario #2 – Missing bags (Canadian citizen)

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1. Canadian traveler's API indicates they checked 5 bags
2. Traveler drafts his e-Declaration on the airplane and indicates 5 bags
3. Traveler submits e-Declaration
4. Traveler only sees 3 of his bags at baggage carousel
5. Traveler reports 2 lost bags (fills e-A23 form) → gets receipt
6. Traveler heads to Egress
7. Face Recognition workflow links the traveler to number of bags
8. Information displayed on screen for an officer for verification
9. Send traveler to Mobile Enforcement Officer.
10. Traveller shows A23 receipt
11. OK

The STORY:

Nate Delacour is a Canadian citizen who is moving back to Canada after living in Dublin, Ireland for 2 years. Nate downloaded the CBSA app on his mobile phone, created his "My Profile," and generated his initial RBR last year, but the CBSA system still sometimes requires him to check in at a Primary kiosk for RBR validation. When Nate checks in at the airport in Dublin, the airline sends his API to the CBSA Targeting centre and indicates that he has checked 5 pieces of luggage.

On the plane ride home to Ottawa, Ontario, Nate fills in his e-Declaration using the app on his mobile phone, reports that he has 5 checked bags with him on the flight, and confirms his declaration using his facial biometric. On arrival at Ottawa International Airport, Nate grabs his carry-on luggage, disembarks, and walks towards the Primary zone with the other travellers. On the way, Nate submits his e-Declaration. The CBSA app then directs Nate to proceed to a Primary kiosk for RBR validation and generates a barcode on his mobile phone.

Nate goes to kiosk #7 in the Arrival Hall. The kiosk scans the barcode on his phone and reads his e-passport. Kiosk #7 also takes an RBR validation photo of Nate and the CBSA system has no problem matching the RBR codes. The app then notifies Nate that he can proceed directly to the baggage carousel to pick up his luggage.

Nate goes to pick up his bags at the international baggage carousel, but while all the other travellers on his flight have retrieved their luggage, he finds that only 3 of his bags have arrived. The CBSA app asks Nate if he has retrieved all his luggage – he answers "No." Therefore the app directs him to go to the airport's "Lost Baggage" counter. Frustrated, Nate talks to Henry Granger at the "Lost Baggage" counter. Henry helps Nate report his 2 lost bags by completing an e-A23 form on an airport kiosk. The airport kiosk prints out a paper A23 receipt for Nate to keep. Henry promises that the airport will contact Nate as soon as they figure out where his lost luggage has gone. The app now asks Nate if he has his paper A23 receipt – Nate answers "Yes." The app now directs him to proceed to the Egress zone.

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Nate enters Egress lane #4 and walks forward with his 3 bags on his push cart. As Nate walks past an overhead camera, the Face Recognition flow control system recognizes that he is a   who should have "5 bags" with him

Frank Potter, a security officer who is tasked with monitoring Egress lane #4, sees the information on the display screen, but then looks down and notices that Nate only actually has 3 bags with him. Frank gently waves Nate out of the Egress line, and calls over the CBSA Enforcement Officer stationed at Egress, Esther Diggory.

Esther Diggory heads to Egress lane #4 for a quick conversation with Frank Potter about the reason why Nate was pulled aside. Esther then approaches Nate Delacour and asks him about his missing bags. Nate explains that he has already filed an e-A23 about his missing bags, and shows Esther his A23 receipt. Over the next minute, Esther concludes that she has no reason to believe that Nate is a threat. Esther then tells Nate that he can proceed to the exit of the CBSA processing area and leave the airport.

SEE MAIN TEXT OF REPORT FOR SCENARIO #3

Scenario #4 – Passport Renewal (Canadian traveler)

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1. Canadian traveler gets mobile app for entering Canada
2. Traveler creates "My Profile" (RBR)
3. App indicates to the traveler that their passport is close to expire date.
4. Traveler poses a question to CBSA on the mobile app
5. CBSA answers the question (provides "Did You Know?" trivia)
6. Allow trip history to be viewed (passport stamp)
7. Traveler buys a ticket
8. Check in (e-check in)
9. Get passport info – flag passport expiry date to traveller
10. In flight
    a. Traveler fills e-Declaration
    b. Traveler buys duty free items
    c. Traveler updates e-Declaration
11. Arrival
    a. Traveler submits e-Declaration
    b. App reminds traveler that passport is about to expire
12. Primary Kiosk
13. App invites traveler to start passport renewal process on mobile

The STORY:

Ruth Organa is a Canadian citizen who has been living with relatives in New Delhi, India for the past 3 months and is about to travel back to Ottawa, Canada. While still in New Delhi, she downloads the CBSA app, creates her CBSA "My Profile," generates her initial RBR, and scans her passport chip. The app indicates to Ruth that her Canadian passport is due to expire in 7 months.

Ruth poses a question to the CBSA on the mobile app about duties and fees, and the app answers her question via a "Did You Know?" trivia section.

Ruth also happens to be in the process of renewing her Top Secret clearance for the Government of Canada, and she knows that one of the questions on the clearance forms is about trip history over the past 10 years. So while she is still in the CBSA mobile app, she takes a few moments to request her "Passage History" list from the CBSA.

The CBSA receives Ruth's "Passage History" request. The list is drawn together, prepared into a PDF, and the document is emailed to Ruth within 2 days.

Ruth buys her ticket back to Canada and checks in for her flight (e-check in).

While on the flight, Ruth fills in her e-Declaration, reports that she has 1 checked bag with her, and confirms her declaration using her facial biometric. 2 hours later, on a whim, Ruth decides to buy some

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duty-free bourbon on the flight, so she then updates her e-Declaration and once again confirms her declaration using her facial biometric.

On arrival at the Ottawa International Airport, Ruth grabs her carry-on luggage, disembarks, and walks towards the Primary zone with the other travellers. On the way, Ruth submits her e-Declaration. The app tells Ruth that she is still under the limit for her declaration so she will not have to pay any duties or fees. However, as a first-time user of the Chain of Trust program, the app notifies Ruth that she will have to present herself at a Primary kiosk in the Arrival hall for "photo validation."

Ruth goes to Kiosk #5 in Arrival Hall, takes her RBR photo and the system has no problem matching her RBR codes.

The app now notifies Ruth that she can therefore proceed directly to the baggage carousel in the Intermediate zone.

Ruth picks up her luggage at the baggage carousel and then heads to the Egress zone. Ruth enters Egress lane #7 and walks past an overhead camera which is connected to the Face Recognition flow control system. As she walks forward, Luke Walker, the security officer stationed at Egress lane #7,

Luke looks down and confirms that Ruth does indeed have only one bag, so he lets her proceed to the exit of the Egress zone and leave the airport.

2 months later, and now that Ruth is back on Canadian soil, the app reminds Ruth that her passport is set to expire in 5 months and invites her to complete the passport renewal process on her mobile. Ruth appreciates the reminder and spends a few minutes completing her passport renewal application on the smartphone app.

To verify her identity, Ruth is asked to scan her existing passport with her phone and to submit a digital picture of herself. The app provides instructions for how to take a photo of acceptable quality. Ruth completes her renewal application and submits her payment. Because Ruth's photo is of acceptable quality,

:   the app informs Ruth that her passport application has been received.

The next day, Ruth receives an email notifying her that her renewal application has been approved, and provides her with the option to pick up the passport at her local passport office or have it mailed to her home.

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Chain of Trust (CoT)
Exercise 3 - Outcomes and Notes

Date: January 24, 2018   Reference: CoT20180124

Exercise 3 Summary Report:
The Chain of Trust project held its Exercise 3 at the CBSA Science and Engineering Facility from December 5th to 7th, 2017 (with a pre-exercise testing session on site on December 4th, 2017). The exercise was the third of four major exercises planned for Chain of Trust. Exercise 3 incorporated the lessons learned from the previous exercise held in September 2017.

Exercise 3 followed the model of Exercise 2 by having volunteer actors play the role of "travellers" and "Roving BSOs" moving through the travel continuum as written in five pre-scripted operational scenarios (see Annex 2 and 3). Whereas Exercise 2 focussed on executing a single operational scenario, Exercise 3 expanded the number of scenarios tested, including a new mobile enforcement scenario. The first four scenarios outlined the movements of individuals travelling to Canada, including simulated travel data for each step (from their initial trip planning all the way through to their eventual egress from the Canadian airport). A fifth scenario was used to showcase a potential "day-in-the-life" of two Roving BSOs who were dispatched with the mobile enforcement technology. This scenario-based approach allowed for a practical assessment of both the system's design and the user's experience as they interacted with the technology.

As with the previous exercise, to protect privacy and sensitive information, no real passports or personal phones were used in the Exercise. Simulated traveller data was provided in the scenario scripts, and the travellers used specimen passports and dedicated mobile devices throughout testing. Additionally, sensitive information relating to CBSA and IRCC operations was excluded from the scope of the exercise.

In addition to running the scripted scenarios, the project team spent some time "free-flow testing" the system – allowing the travellers to interact with the technology in an unscripted manner. The systems generally performed well through these tests, which were designed to give a broader sense of user experience, performance and robustness to more real-world scenarios. Notably, the testing allowed assessment of the robustness of the system to handling several differing types of travelers moving through the arrivals hall simulation at the same time.

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In Exercise 2, some aspects of the system still required manual intervention to facilitate communication between project components and the system orchestrator. However, Exercise 3 demonstrated a higher degree of technological fidelity, with increased level of communications between systems and increased automation of the system as a whole. Exercise 3 also saw significantly improved communication between the Orchestrator system, the Mobile Enforcement Command, and Roving BSOs through the use of mobile and smart watch messaging.

As with the previous exercise, guest observers from CBSA and IRCC were invited to attend a portion of the exercise to better understand the work and its connection to departmental objectives. Shortly after the exercise, the project partners also reconvened at the site to provide a demonstration of the system to a small delegation from McKinsey and Company, who the CBSA has engaged on a separate project.

Exercise 3 – Final day observations:
The final day of Exercise 3 was set aside for reviewing progress, noting challenges, and determining how to proceed going forward.

Among the issues discussed:
- The need for further validation to ensure that the orchestrator messages can be reliably sent and received in cases where messages are moving in higher volumes and short intervals.
- The need for additional work to ensure the reliable functionality of the project's Renewable Biometric Reference technology, which is used to securely validate traveler identity in a privacy-respecting manner. Strategies included incorporating additional training data to strengthen the matching algorithm.
- Clarification of the project vocabulary: the project team spent some time standardizing some terms that had been causing communications problems between project partners due to differing interpretations by different micro-teams (e.g., "enrollment", "traveler", "zones").
- The possible need for a master orchestrator in addition to orchestration functions that are specific to the destination airport.
- Also discussed was the flow control logic -- which is specific to the destination airport layout -- and where that logic would reside (orchestrator vs flow control system).
- Changes to the information displayed to CBSA staff working at egress: An indicator for the number of bags a traveller is carrying will be replaced with one indicating the number of travelers within a group. For the project, this information is displayed largely to demonstrate that the system is capable of automatically displaying some useful information to the CBSA officer/staff working at the egress point.
- Changes to the rhythm of work:

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- o In the lead up to Exercise 3, Chain of Trust partners had continued to work through micro-teams to advance system components, building on the information gathered from Exercise Two. Design Team meetings were held on a bi-weekly basis, and teams would undertake additional testing as required using the dedicated project space at 79 Bentley.
- o At the end of Exercise 3 it was decided that the project team would change the rhythm of work going forward to Exercise 4. The project team will now meet weekly (Tuesday afternoons) for "Exploration" meetings to discuss work and divide tasks, while bi-weekly "Testing meetings" will be held on-site every second Thursday afternoon.

Exercise 4, planned for March 6-9th 2018, will further develop the scenarios, address remaining challenges, and further refine the system's operation and realism.

Micro Team reports: Progress, Challenges, and Next Steps
To support the development of this report, each micro-team leader was asked to provide their notes from Exercise 3. These notes listed the elements that worked, those that did not, and outlined the remaining work that needs to be done. Summaries of these notes are provided below:

➢ **TRAVELLER MOBILE APP ("MY TRAVEL" APP):**
As with Exercise 2, travellers were still able to complete their activities on the app (e.g. create profile, apply for an eTA if non-Canadian, complete and submit their e-Declaration, etc.); however with Exercise 3, we added new on screen message notifications. These messages popped-up on the traveller's mobile screen and could tell them their next step in the process (eg. proceed to Primary, collect bags, proceed to egress, etc). This new function seemed to work very well, even when multiple travellers were completing tasks at same time. However, we did initially encounter some issues with the messages and functionality of the app when multiple travellers checked in for the same flight.

Some issues with interaction from MyTravel app and the orchestrator were also uncovered as part of this exercise. For example, because the Canadian specimen passports used for the exercise all had the same name, date of birth and expiry, this created some confusion when trying to distinguish travelers during the scenario. This created some confusion when trying to identify which travellers were being flagged for lookout by Mobile Enforcement and for distinguishing travelers on the Orchestrator dashboard. This problem will be fixed by creating our own project-specific "passports" going forward.

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After Exercise 2, WorldReach had coded the MyTravel app to only force the traveller to validate their RBR photo at a Primary kiosk on their initial trip into Canada, after which they could bypass this step. So in order to have the travellers "fly" multiple times and be sent to Primary on those subsequent trips, the trip records needed to be cleared each time the traveller went around. The plan had been to use all live interactions for Exercise 3, but this issue became a bit of a hassle as we continued with testing. Furthermore, RBR generation had to be artificially completed for a lot of the travellers using code WR had implemented for Exercise 2.

Also noted, was that mobile enforcement was seeing some data from the WorldReach internal test environment (e.g. photo for a traveller – was showing as a tester from WorldReach instead of the Exercise participant who had created a profile with the passport). This situation was caused by the WorldReach server in both the test and Exercise environments having used the same passports and communicating with a single Orchestrator. There is need of separate environments.

Next steps include:
- Fix MyTravel and Orchestrator interaction to allow concurrent trips by multiple travellers.
- Modify configuration of MyTravel app to not use NFC in the phone to read eChips in passports. This will allow the use of lots of paper based passports with different made up names for next exercise (resolve the issues caused by specimen passports having the data).
- Create separate test and exercise environments in the Cloud for all partners to use.

➢ **KIOSKS (Check-in, Primary & Intermediate):**
The Check-In kiosks performed well with travellers able to complete the small number of steps as required for the check-in process. The Primary Kiosk worked well for most passport reading, although problems with verification of identity (via RBR) sometimes created issues for the kiosk's operation. The Intermediate kiosk had no problem with paying fees and duties.

Next steps include:
- Modify check-in kiosk to allow identification of number of travellers in a group.
- Modify Primary kiosk to not require reading of chip in passport (as noted for MyTravel app)

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➢ **CBSA MOBILE ENFORCEMENT APP AND DISPATCH SYSTEM**

The CBSA Mobile Enforcement aspects of the project worked well in isolation, although some issues remain relating to system integration and the data movement between systems. Slow network speeds for the simulation also caused some issues.

Next steps include:
- Add a database to manage Mobile Enforcement Officers (MEOs)
- Setup development and production environments
- Fix significant bugs
- Integrate beacons for the indoor traveler localization
- Time permitting, integrate Google Glass for mobile officer display

➢ **RENEWABLE BIOMETRIC REFERENCE (RBR)**

The RBR service worked as it should without any technical or algorithmic problems; however the system had some trouble passing/failing specific travelers according to the needs of each scenario. This led to problems when trying to test particular scenarios. The RBR parameter was modified on the fly during the Exercise to various degrees of success for some scenarios, but not all conditions could be targeted simultaneously for all scenarios.

The RBR back-end code and the web service part have been combined. The RBR service has been uploaded and is successfully running on the cloud and it worked as intended. It can automatically generate a client's RBR, verify an RBR and generate and verify the e-declaration "biometric signature." A photo format has also been agreed upon to match the training data with the selfies taken at different points during the process by WorldReach's applications.

The RBR parameter needs to be tuned to increase performance and accuracy. The RBR service accuracy issues are caused by the limited training and testing data available to us at this time. A better trained feature extractor will improve the results. Significant differences in lighting and camera quality between the enrollment photos and the kiosk validation pictures were responsible for some of the authentication failures seen during the three days of the exercise.

Next steps include:
- The data collected during the exercise will be looked at and analysed to select better parameters for the service.
- Accuracy improvements will be researched.

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- Explore the possibility of improving photo pre-processing: potentially with the assistance of Face4
- Create a quantitative measurement for photo variance in enrollment photos (lower priority, but still valuable).

➢ ORCHESTRATOR

In general the orchestrator system functioned as expected. We were able to run through all the scenarios, the rules fired as expected, and the traveler flow was updated correctly. Messages were sent and received by appropriate systems.

There were some issues relating to output messages sent too close together (virtually at the same time), which were missed by receiving systems. An artificial user-evoked delay was introduced to accommodate this in the scenarios. Timer automation, used in scenario three, was still performed manually. Record clearing between systems was not automated and often caused errors. For example, the travel record would be cleared, but the Face4 cache was still present causing facial mismatch.

Artificial attempts to rectify real people with a passport that was not their own caused confusion with traveller coordination. We tried a stop-gap method in the orchestrator by renaming passport data to another traveller, but this was very hard to manage and in the end was abandoned. Traveller database records would get too big and slow down the system to an unworkable level. Picture data was too large and could cause network delays.

Next steps include:

- Remove picture data from the Travel Record to and set as attachment (instead of inline with the record). This should reduce database slowdowns on query.
- Create a thumbnail and full size version of every picture received by Orchestrator to reduce network traffic of images.
- Add the automation timer into orchestrator to allow time rules to be processed automatically.
- Add the archive sequence and archive output message to allow other systems to synchronize cleanup.
- Remove the artificial stop gap methods to synchronize travelers and passports.

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> ## IRCC PREDICTIVE ANALYTICS

For Exercise 2, a simple R script was used to demonstrate the real-time flow of the risk scoring within the eTA application process. The WorldReach server was used to simulate the real-time risk scoring as part of the eTA assessment process. A realistic machine learning risk scoring system (built using simulated traveler data) developed for this project was demonstrated separately from the direct traveller flow using an IRCC laptop. This was done intentionally to avoid exposing the underlying code and scoring criteria. This same configuration was used for the live exercise testing for Exercise 3 – that is, a simple script was used on the WorldReach back end to demonstrate the communication aspects of the real-time eTA scoring, with a more advanced realistic scoring model demonstrated separately on an IRCC laptop.

For Exercise 3, IRCC Predictive Analytics further advanced the scoring algorithm used in Exercise 2, including parallelizing the code for faster model training and the development of an interactive version of the risk scoring model, allowing users to query specific cases for examination.   The intention was to replace the simple scoring script used in the live exercise with this model for Exercise 3.

Next steps for IRCC Predictive Analytics include:

- Provide the new modeling code for inclusion in the WorldReach back-end.
- Completion of a risk dashboard designed to demonstrate how the IRCC officers might use this model for assessing organized fraud trends.
- Exploration of the possibility of combining the high-accuracy "black box" and high-interpretability "white box" machine learning scoring models generated for this project.

> ## CBSA PREDICTIVE ANALYTICS

For Exercise 3, the 'data suggested' model has been pre-trained based on mock data, which has been constructed based on Border Service Officers' heuristics and Statistics Canada data. The 'data suggested' model has been deployed on the cloud and can automatically update and send the corresponding scores to the Orchestrator system by listening to messages. The mock data is relatively biased, and the PA engine may not be a good indicator if the stream data doesn't 'look like' the mock data. However, the

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Predictive Analytics engine is good at learning patterns from the historical data itself. Some challenges have been faced relating to the time-sensitive heuristics, which usually are required for additional triggers and rules. An example of a time-sensitive heuristic derived from discussions with a Border Service Officer would be that the BSO notices that multiple passengers on a single flight are displaying an unusual cough, at the same time that a possible pandemic concerns have been in the media. In this scenario, all travelers arriving on this flight would be triggered to a   in the orchestrator in order to quarantine them.

Next steps include:

- Developing a 'bad' travelers scenario/use case for which the predictive analytics engine can show a high-risk score with a decent explanation or guide.
  Additional discussions with Entrust relating to the possible development of a use case involving time-sensitive heuristics.

➢ **FACE RECOGNITION/TRAVELER FLOW**
In general, the flow control worked as expected and no major problems were observed. All face images submitted to the central database were successfully enrolled into local databases for all lanes. Upon receiving an Egress message all traveler data was removed from local databases for all lanes. Lanes with 4 and 3 sensors performed equally well.

Next steps include:

- Switching to a single database for all lanes. This will help with synchronizing the watchlist for all lanes.
- In case of an exception, (e.g., someone walks through a lane in the opposite direction), the lane controller requires a manual reset. We will implement an automatic reset after a certain period of time.
- Continue to fine-tune the state machine.
- Implement changes related to integration with other components. The following expected changes will affect the work of flow control: Changes to the Development/Staging environment, Orchestrator, Central Database etc.

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Annex documents

In the following pages please find the following documents:

- o Annex 1: Scenario stories used in Exercise 3
- o Annex 2: Scenario scripts for participants used in Exercise 3

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Annex 1 – Scenarios stories used for Exercise 3

Note that these scenarios are living documents subject to further refinement as the project progresses to ensure an operationally realistic scenario. Several changes will be developed for future exercises. *See Main text of this report for the description of how these stories were used in Exercise 3.

SCENARIO STORIES

Scenario #1 – Broken RBR (Canadian traveller)

Jim Dayne is a Canadian citizen who is returning home to Montreal, Quebec after a week-long vacation in El Paso, Texas. On the plane ride back to Montreal he drafts his e-Declaration using the MyTravel app on his mobile phone (he reports that he is bringing 4 bottles of expensive bourbon back with him) and then 'signs' his declaration using his facial biometric.

Daniel Tarth is the CBSA POE Administrator at Pierre Eliot Trudeau International airport. Early in the morning, Daniel looks at his operations dashboard (which provides information from the airport authority, iAPI, and other sources) and he sees that there are 20 incoming flights scheduled to arrive later in the afternoon (including Jim Dayne's flight). Understanding that there will soon be an influx of travellers, Daniel tells Hannah Clegane at CBSA Mobile Enforcement Command of the extra incoming flights, and she quickly calls in 5 extra Enforcement Officers to work during those hours. Hannah can decide where to assign these officers based on traveller flow needs.

(Check-In) (Flight Departure) (Draft e-Declaration) (Flight Arrival)

Once the plane has arrived at the airport, Jim grabs his carry-on luggage, disembarks, and starts walking towards the Primary zone. While walking with the other travellers, Jim submits his e-Declaration on his mobile phone. The CBSA system compares Jim's e-Declaration RBR with the RBR from his MyTravel profile and has no problem validating Jim's e-Declaration identity. However, the MyTravel app on Jim's mobile phone tells him that he has two administrative tasks to complete today: (1) the CBSA system has decided to validate Jim's RBR today, so he will have to go to a Primary kiosk for an RBR validation photo, and (2) he has exceeded his alcohol allowance and will have to pay his duties and taxes at a kiosk.

Jim goes to kiosk #13 in the Primary area. The kiosk asks Jim to present his passport, so he follows the on-screen instructions and the kiosk scans the MRZ chip on his passport. The kiosk then tells Jim to stand still for an RBR validation photo to confirm his identity. Jim smiles as the photo is taken and waits for further instruction. However, the CBSA system is unable to validate the RBR photo taken at the kiosk – it seems that the new RBR code is now failing to match up with Jim's MyTravel RBR code. Three things happen at this time: (1) Jim is   (2) kiosk #13 notifies Jim that there is a

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problem with confirming his identity and tells him to stay at the kiosk while a customs officer comes to talk to him, and (3) the kiosk sends an alert to the Orchestrator about the RBR issue.

While Jim is waiting at the kiosk, the Orchestrator forwards the alert to the CBSA Mobile Enforcement Command system. Hannah Clegane at Mobile Enforcement Command sees the alert and dispatches BSO Brendan Martell, a CBSA Roving Officer currently stationed in the Primary zone, to confirm the identity of the traveller at kiosk #13.

BSO Brendan receives the notification on his wrist-mounted mobile device, acknowledges the alert, and then heads towards kiosk #13.

BSO Brendan approaches Jim and explains why he is there. BSO Brendan interviews Jim over the next few minutes and soon realizes that Jim is indeed who he says he is. BSO Brendan decides to override Jim's   RBR match error in the system - he uses his mobile device to override the RBR error. Jim Dayne now turns back to the kiosk to continue with paying his duties and taxes.

Jim pays his fees (and is now made   in the system).

Jim goes to the baggage carousel, retrieves his suitcase, and proceeds to the Egress zone. As he enters Egress lane #2, the Face Recognition flow control system identifies "Jim Dayne" and displays that he is a   who should have "one" piece of luggage with him.

Lydia Bronn, the security officer monitoring Egress lane #2, sees the displayed information and then looks over to confirm that Jim Dayne does indeed have only one bag. Lydia allows Jim to proceed forward, exit the Egress zone, and enter Canada.

Scenario #2 – Missing bags (International traveller)

Nate Delacour is an Irish citizen who is going to visit Canada from Dublin, Ireland. Nate has travelled to Canada 6 times in the last 2 years. He has already downloaded the MyTravel app on his mobile phone, created his Profile, and generated his initial RBR last year, and received his eTA. However, the CBSA system still sometimes requires him to check in at a Primary kiosk for RBR validation. When Nate checks in at the airport in Dublin, the airline sends his API to the CBSA Targeting centre and indicates that he has checked 4 pieces of luggage.

(Check-In) (Flight Departure)

On the plane ride home to Ottawa, Ontario, Nate fills in his e-Declaration using the app on his mobile phone, and 'signs' his declaration using his facial biometric.

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(Draft e-Declaration) (Flight Arrival)

On arrival at Ottawa International Airport, Nate grabs his carry-on luggage, disembarks, and walks towards the Primary zone with the other travellers. On the way, Nate submits his e-Declaration. The MyTravel app then directs Nate to proceed to a Primary kiosk for RBR validation.

Nate goes to kiosk #7 in the Arrival Hall. Nate presents his e-passport to the kiosk and then stands still for an RBR validation photo. The system quickly makes a biometric match to Nate's MyTravel RBR code, so the MyTravel app notifies Nate that he can proceed directly to the baggage carousel to pick up his luggage and proceed to the Egress zone.

Nate goes to pick up his bags at the international baggage carousel, but while all the other travellers on his flight have retrieved their luggage, he finds that only 2 of his bags have arrived. Frustrated, Nate walks over to the "Lost Baggage" counter and talks to Henry Granger. Henry helps Nate report his 2 lost bags by completing an e-A23 form on an airport kiosk. The airport kiosk prints out a paper A23 receipt for Nate to keep. Henry promises that the airport will contact Nate as soon as they figure out where his lost luggage has gone. The MyTravel app now directs him to proceed to the Egress zone.

Nate enters Egress lane #4 and walks forward with his 2 bags on his push cart. As Nate walks past an overhead camera, the Face Recognition flow control system recognizes that he is a '
who should have "4 bags" with him.

Frank Potter, a security officer who is tasked with monitoring Egress lane #4, sees the information on the display screen, but then looks down and notices that Nate only has 2 bags with him. Frank gently waves Nate out of the Egress line, and calls over the CBSA Enforcement Officer stationed at Egress, Esther Diggory.

Esther Diggory heads to Egress lane #4 for a quick conversation with Frank Potter about the reason why Nate was pulled aside. Esther then approaches Nate Delacour and asks him about his missing bags. Nate explains that he has already filed an e-A23 about his missing bags, and shows Esther his A23 receipt. Over the next minute, Esther concludes that she has no reason to believe that Nate is a threat. Esther then tells Nate that he can proceed to the exit of the CBSA processing area and leave the airport.

Scenario #3 – Time delay triggered (International traveller)

Marie Bennet is a French citizen who completed her undergraduate degree at the University of British Columbia on an approved student permit 10 years ago. Marie is now planning a trip from Paris, France, back to Vancouver, BC to visit some friends from university. Marie downloads the MyTravel app onto

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her mobile phone and creates her Profile by following the instructions on the screen. She scans her passport, enters her personal information, and takes 7 selfie pictures of herself in order to generate her initial RBR code. As a foreign national from a visa-exempt country, Marie requires an eTA to visit Canada. She uses the app to complete her eTA application, pay the IRCC transaction fee, and send her application to IRCC for review.

Marie's eTA is approved within seconds and she receives notification of this approval on her mobile phone.

Marie buys her tickets to Canada. Two days later, she arrives at Charles de Gaulle airport in Paris, France and checks-in for her flight. At this time the CBSA starts Marie's "Trip Record" in the system.

(Check-In) (Flight Departure)

On the plane ride to Vancouver, Marie drafts her e-Declaration using the app on her mobile phone and 'signs' her declaration using her facial biometric (she takes a selfie on the plane).

(Draft e-Declaration) (Flight Arrival)

Marie disembarks the plane in Vancouver and sees that she has wi-fi now available, so she opens her MyTravel app and submits her e-Declaration. The app then notifies Marie that, as a new enrolee in the Chain of Trust program, she will need to present herself at a Primary kiosk in the Arrival hall for "photo validation."
Marie makes her way to the Arrival Hall.

However, an hour passes by and the Orchestrator system notes that "Marie Bennet" still hasn't presented herself at a Primary kiosk, nor has the Face Recognition flow control system captured her moving anywhere past the Arrival hall.

Andria Bingley, a CBSA Mobile Enforcement Officer, finds Marie Bennet sitting in the Arrival area. Andria using her wrist-mounted mobile device, then approaches Marie. It turns out that Marie's mobile phone had been about to run out of power, so she had plugged her phone into a free outlet on the wall and was waiting for it to re-charge. After a lengthy interview, Andria determines that she sees no reason to keep Marie's   so she uses her wrist-mounted

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mobile device to downgrade Marie to   in the system (since Marie still needs to complete her photo validation at a Primary kiosk). Andria then directs Marie to present herself at a Primary kiosk as soon as possible, and then goes back to her roving duties.

Marie picks up her mobile phone and goes to kiosk #11 in the Primary zone. Kiosk #11 takes a photo of Marie and validates her RBR codes. Marie is now made "   in the system and directed to the baggage carousel in the Intermediate zone. Marie goes to the baggage carousel and easily picks up her 2 bags. Marie is then directed by the app to enter one of the Egress lanes.

In Egress lane #4, the Face Recognition flow control system recognizes "Marie Bennet" and shows that she is a "   ' traveller with "one" piece of luggage. Johnathon Darcy, the security officer at Egress lane #4, sees this information displayed on a screen and confirms that Marie does indeed have only one bag. Jonathan lets Marie proceed to the exit of the Egress zone and leave the airport.

Scenario #4 – Passport Renewal (Canadian traveller)

Ruth Organa is a Canadian citizen who has been living with relatives in New Delhi, India for the past 3 months and is about to travel back to Ottawa, Canada. While still in New Delhi, she downloads the MyTravel app, creates her Profile, generates her initial RBR, and scans her passport chip. The app indicates to Ruth that her Canadian passport is due to expire in 7 months.

Ruth has a question about duties and fees, so she taps the "Frequently Asked Questions" tab on the mobile app and navigates through her specific questions. The app is very helpful and answers all her questions.

Ruth also happens to be in the process of renewing her Top Secret clearance for the Government of Canada, and she knows that one of the questions on the clearance forms is about her trip history over the past 10 years. So while she is still in the MyTravel mobile app, she takes a few moments to request her Passage History from the CBSA.

The CBSA receives Ruth's Passage History request. The list is drawn together, prepared into a PDF, and the document is emailed to Ruth within 2 days.

Ruth buys her ticket back to Canada and checks in for her flight.

(Check-In) (Flight Departure) (Draft e-Declaration)

While on the flight, Ruth fills in her e-Declaration and 'signs' her declaration using her facial biometric. Two hours later, Ruth realizes that she had accidently put the wrong flight number on her declaration, so she re-opens her e-Declaration and easily changes this information.

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(Flight Arrival)

On arrival at the Ottawa International Airport, Ruth grabs her carry-on luggage, disembarks, and walks towards the Primary zone with the other travellers. On the way, Ruth submits her e-Declaration. Since Ruth is still under the limit for her declaration, she will not have to pay any duties or fees; however, as a first-time user of the Chain of Trust program, the app notifies Ruth that she will have to present herself at a Primary kiosk in the Arrival hall for "photo validation."

Ruth goes to Kiosk #5 in Arrival Hall, takes her RBR photo and the system has no problem matching her RBR codes.   The MyTravel app now notifies Ruth that she can therefore proceed directly to the baggage carousel in the Intermediate zone.

Ruth picks up her luggage at the baggage carousel and then heads to the Egress zone. Ruth enters Egress lane #7 and walks past an overhead camera which is connected to the Face Recognition flow control system. As she walks forward, Luke Walker, the security officer stationed at Egress lane #7,
                                          traveller who should have one piece of luggage. Luke looks down and confirms that Ruth does indeed have only one bag, so he lets her proceed to the exit of the Egress zone and leave the airport.

Two months later, and now that Ruth is back on Canadian soil, the app reminds Ruth that her passport is set to expire in 5 months and invites her to complete the passport renewal process on her mobile. Ruth appreciates the reminder and spends a few minutes completing her passport renewal application on the smartphone app.

To verify her identity, Ruth is asked to answer some standard passport renewal questions and submit a new digital picture of herself (the app provides instructions for how to take a photo of acceptable quality). Once finished filling in the information and taking her photo, Ruth submits her renewal application and pays the renewal fee with her credit card. She is presented with a QR code containing her pertinent data, that can be presented if she needs to visit the passport office to review her application.

Soon after, Ruth receives an email notifying her that her renewal application has been received by IRCC and is now being processed. IRCC reviews Ruth's updated information and photo, and does all their usual background checks on "Ruth Organa."

4 days later, the mobile app alerts Ruth that her application has been approved and alerts her that she can pick up her new passport at her local passport office.

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Scenario #5 – BSO Scenario (A day in the life of a Roving BSO):

➤ BSO Devin Kent starts his day at the Hatfield International Airport. He reports to his supervisor and is informed that he will be on Roving duties today.

➤ BSO Devin reports to the Mobile Enforcement Command office and talks to BSO Thérèse Wayne who is working as the dispatch officer today.

➤ BSO Thérèse gives BSO Devin one of the mobile devices and a watch.

➤ BSO Devin takes the mobile device and signs into the Mobile Enforcement Command system using his Username and Password.

➤ Once the Mobile Enforcement Command system has 'Activated' 'BSO Devin' and located his mobile device with geo-location, the system sends a notification to BSO Devin's mobile device which tells him that he can proceed with his Roving duties.

➤ BSO Thérèse now uses the Mobile Enforcement Command system to dispatch BSO Devin to the baggage carousel area.

➤ BSO Devin taps the "Roving" button on the watch screen and then heads out to the baggage carousel area.

➤ On arrival, the system notifies Mobile Enforcement Command that BSO Devin has arrived at his assigned zone (using geo-location).

➤ After a bit of roving, BSO Devin sees a traveller behaving suspiciously and decides to talk to him.

➤ BSO Devin taps the "Engaged" button on the watch screen and walks up to the traveller.

➤ BSO Devin asks the traveller for their name – "Jack Napier" – and then his passport. BSO Devin scans the traveller's document with his mobile device.

➤ BSO Devin now sees Jack Napier's electronic profile on his mobile device and reviews the information that is on screen.

➤ BSO Devin conducts a quick interview with the traveller, and soon suspects that Jack Napier may be bringing illegal substances into Canada.

➤ BSO Devin smiles, says goodbye, and walks away from Mr. Napier.

➤

➤ BSO Devin also marks his suspected reasons for the referral by picking from a subsequent drop-down list:
  ↳ Drugs, weapons, target, goods, immigration, other.

➤ (Jack Napier will now be diverted at Egress)

➤ BSO Devin now taps the "Roving" button on his watch screen.

➤ An hour later, BSO Devin receives a notification from the Mobile Enforcement Command that he has been re-assigned to the Arrival Hall.

➤ BSO Devin taps the "Acknowledged" button on his screen and starts walking towards the Arrival Hall (the geo-location system knows where he is as proceeds through the airport).

➤ On his way there, BSO Devin receives a Red Alert for reinforcement. His mobile device tells him to look for Officer Sylvie Prince who is at a location 100ft away from him in the Intermediate Hall (his mobile device shows her approximate location on screen through geo-location).

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- ➤ BSO Devin taps the "Responding" button and starts running through hundreds of Travellers towards the location shown on screen. (By tapping the "Responding" button, this also marks BSO Devin as "Engaged" in the system without him having to press another button).
- ➤ BSO Devin finds Officer Sylvie and helps her subdue a drunk and unruly traveller in the Intermediate Hall.
- ➤ Once finished, BSO Devin taps the "Roving" button again, and continues towards the Arrival Hall (the geo-location system knows where he is as moves).
- ➤ On arrival, the system notifies Mobile Enforcement Command that BSO Devin has arrived to his re-assigned zone.
- ➤ A moment later, BSO Devin receives notification from the Mobile Enforcement Command that there is a broken RBR issue at Kiosk # 6 - "Please confirm identity of traveller"
- ➤ BSO Devin approaches the traveller at Kiosk # 6, taps his "Engaged" button, and talks to the traveller – Veronica Pennyworth.
- ➤ BSO Devin quickly confirms Veronica's identity and downgrades her from   in the system.
- ➤ He overrides the RBR issue using his mobile device. This override tells the system to continue with the rest of Veronica Pennyworth's administrative processes.
- ➤ BSO Devin then says goodbye to Veronica and taps the "Roving" button again.
- ➤ An hour later, BSO Thérèse receives an alert from the Orchestrator that the CBSA database has just flagged an individual as a national security "lookout." The Orchestrator sees that this individual, Peter E. Nigma, has just arrived at Hatfield airport.
- ➤ BSO Thérèse now takes this information and sends it out to all active Roving BSOs.
- ➤ BSO Devin receives the lookout alert for a traveller that should be somewhere in the Arrival Hall.
- ➤ BSO Devin looks at his mobile device to review the known information about the traveller (Name: Peter E. Nigma, Sex: Male, Age: 42, Ethnicity: White, Hair colour: Black, Last seen wearing: Green jacket and jeans) – along with any available pictures (passport, profile photo, scene photo, etc.)
- ➤ BSO Devin keeps roving and soon comes across the traveller in question.
- ➤ BSO Devin takes ownership of the lookout alert (which cancels it for everyone else).
- ➤ BSO Devin now taps the "Engaged" button, and approaches the traveller to conduct an interview.

Etc. Etc. Etc.

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Annex 2: Scenario Scripts for Participants

Scenario # 1

Jim Dayne	Hannah Clegane	BSO Brendan Martell
(Canadian traveller)	**(Mobile Enforcement Command)**	**(Roving BSO)**

Step 1: Profile Creation
 	
Jim Dayne opens the MyTravel app and creates his profile:
 	
  a. User Email address
  b. PIN: **6666**
  c. Scan the **picture page** of your **passport** (make sure the bottom 2 lines of the page are in the scan window of the camera)
  d. Take **1 Profile photo** (your normal, relaxed face)
  e. Take **7 RBR photos** (various facial gestures)
 	
Jim is ready to fly!
		Step 1: Sign In to MEC system
		
		BSO Brendan Martell signs into the Mobile Enforcement Command system.

	Step 1: Assign Roving BSO to a Zone Hannah assigns Brendan to the Primary zone of the airport.	⅂ **Step 2: Tap "Roving" button on watch** **Step 3: Walk to Primary**

Step 2: Check In
 	
Jim Dayne "Checks In" at the airport:
 	
  a. Scan the **picture page** of your **passport**.
  b. Flight: **AC689**
  c. Bags: **1**
		Step 4: Check In to Primary
		
		On arrival, BSO Brendan "checks in" to the Primary zone using the mobile device.

⟶	*** PRESS THE "FLIGHT DEPARTURE" BUTTON FOR FLIGHT AC689.**	

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Step 3: Prepare e-Dec	

In flight, Jim Dayne prepares his e-Declaration:
 	
  a. Exemptions: **$4000**
  b. Flight: **AC689**
  c. Take RBR **Photo**	

⟶	* PRESS THE "FLIGHT ARRIVAL" BUTTON FOR FLIGHT AC689.

Step 4: Submit e-Dec

Jim Dayne walks off the plane and can now press the "Submit" button for his e-Declaration.

The MyTravel app notifies Jim that he has to go to Primary for (1) photo validation and (2) to pay his duties and fees.

↓

Step 5: Primary Kiosk

Jim Dayne goes to kiosk #13 in the Primary zone. At the kiosk:

  a. Scan the **picture page** of your **passport**
  b. Scan **passport chip**. ↳ Close your passport and hold it next to the back of the kiosk (keep it still for 10 seconds as the reader tries to find the chip)
  c. Take RBR **photo**

THERE IS A PROBLEM WITH THE RBR PHOTO

The kiosk tells Jim to stay at the kiosk while someone comes to help him.

...

...

⌐

Step 2: See Alert

The Orchestrator notifies Mobile Enforcement Command that there is a problem verifying a traveller at kiosk # 13 in the Primary zone.

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Step 3: Forward the Alert to Roving BSO

...

Hannah Clegane forwards the alert to
Brendan Martell.

┐

...

Step 5: See the Alert

BSO Brendan Martell receives the alert and
walks to kiosk # 13.

...

Step 6: BSO Brendan presses the "**Engaged**"
button on his watch.

Step 7: Scan traveller's passport

BSO Brendan talks to Jim Dayne.

BSO Bredan asks for Jim's passport and scans
it with his mobile device.

Jim Dayne hands his passport to BSO
Brendan.

BSO Brendan now reviews Jim Dayne's travel
profile and information on his mobile device.

Step 8: Override RBR issue

BSO Brendan overrides the RBR problem
using his mobile device.

Step 6: Pay Duties and Fees

Jim Dayne now continues to the next step on
the kiosk → paying his duties and fees.

Complete the fields on screen.

Credit card: **4111111111111111**

Step 9: BSO Brendan presses the "**Roving**"
button on his watch.

The MyTravel app notifies Jim that he can
proceed to the Baggage Carousel zone to pick
up his suitcase.

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Step 7: Baggage Carousel
Jim Dayne picks up his bag and proceeds to the Egress zone.

Step 8: Egress
Jim Dayne enters Egress Lane #2.

	Lydia Bronn (Egress Security Officer)	
	Lydia Bronn sees that "Jim Dayne" is a who should have "1" piece of luggage.	
	Lydia lets Jim proceed.	
Jim enters Canada.		

SCENARIO #2

Nate Delacour (International traveller)	Henry Granger (Lost Baggage Counter)	Frank Potter (Egress Security Officer)

Step 1: Profile Creation
 	
Nate opens the MyTravel app and creates his profile:
   a. User Email address
   b. PIN: **6666**
   c. Scan the **picture page** of your **passport** (make sure the bottom 2 lines of the page are in the scan window of the camera)
   d. Take **1 Profile photo** (your normal, relaxed face)
   e. Take **7 RBR photos** (various facial gestures)
   f. Apply for **eTA**
   g. **Pay with your credit card: 4111111111111111**
 	
Nate is ready to fly!		

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Step 2: Check In

Nate Delacour "Checks In" at the airport:

a. Scan the **picture page** of your **passport**.
b. Flight: **AC425**
c. Bags: **4**

⟶	* PRESS THE "FLIGHT DEPARTURE" BUTTON FOR FLIGHT AC425.

Step 3: Prepare e-Dec

In flight, Nate Delacour prepares his e-Declaration:

a. Allowance: **$0**
b. Flight: **AC425**
c. Take RBR **Photo**

⟶	* PRESS THE "FLIGHT ARRIVAL" BUTTON FOR FLIGHT AC425.

Step 4: Submit e-Dec

Nate Delacour walks off the plane and can now press the "Submit" button on his e-Declaration.

The MyTravel app notifies Nate that he has to go to Primary for photo validation today.

↓

Step 5: Primary Kiosk

Jim Dayne goes to kiosk #13 in the Primary zone. At the kiosk:

a. Scan the **picture page** of your **passport**
b. Scan **passport chip**.   ↳ Close your passport and hold it next to the back of the kiosk (keep it still for 10 seconds as the reader tries to find the chip)
c. Take RBR **photo**

The MyTravel app notifies Nate that he can proceed to the Baggage Carousel zone to pick up his suitcase.

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Step 7: Baggage Carousel Nate Delacour picks up 2 of his 4 bags, but can't find the other 2.		
Nate goes to the Lost Baggage counter.	**Step 1: Lost Baggage Counter** Henry Granger shows Nate how to fill in his **e-A23 form**. The airport will contact Nate once they find his missing baggage. Henry gives Nate a **paper A23 receipt** to show the officer at Egress.	
Step 8: Egress Nate Delacour enters Egress Lane #4.		
		Step 1: View Traveller State on Screen Frank Potter sees that "Nate Delacour" is a who should have "4" piece of luggage. However, Frank only sees 2 pieces of luggage on Nate's trolley. **Step 2: Direct Nate out of the Lane** Frank gently waves Nate out of Lane #4 and asks him to wait. **Step 3: Call Roving BSO** Frank calls over BSO Esther Diggory and explains the problem.
	Esther Diggory **(Egress Roving BSO)**	
Step 9: Show A23 receipt Nate Delacour shows his A23 receipt to BSO Esther.	**Step 1: Talk to Traveller** BSO Esther Diggory asks Nate Delacour why he only has 2 bags.	

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Step 2: Review information
BSO Esther reviews Nate's paperwork.
Step 3: Direct traveller
BSO Esther decides to let Nate proceed.
Nate enters Canada.

Scenario #3

Marie Bennet	Jake Austen	BSO Andria Bingley
(International traveller)	(Mobile Enforcement Command)	(Roving BSO)
Step 1: Profile Creation Marie opens the MyTravel app and creates her profile: a. User Email address b. PIN: **6666** c. Scan the **picture page** of your **passport** (make sure the bottom 2 lines of the page are in the scan window of the camera) d. Take **1 Profile photo** (your normal, relaxed face) e. Take **7 RBR photos** (various facial gestures) f. Apply for **eTA** g. Pay with your fake credit card: **4111111111111111** Marie is ready to fly!	**Step 1: Assign Roving BSO to a Zone** Jake assigns BSO Andria to the Primary zone of the airport.	**Step 1: Sign In to MEC system** BSO Andria Bingley signs into the Mobile Enforcement Command system. ⅂ **Step 2: Tap "Roving" button on watch** **Step 3: Walk to Primary**
Step 2: Check In Marie Bennet "Checks In" at the airport: a. Scan the **picture page** of your **passport.** b. Flight: **AC204** c. Bags: **2**		**Step 4: Check In to Primary** On arrival, BSO Andria "checks in" to the Primary zone using the mobile device.

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	* PRESS THE "FLIGHT DEPARTURE" BUTTON FOR FLIGHT AC204.
Step 3: Prepare e-Dec In flight, Marie prepares her e-Declaration: a. Exemptions: **$0** b. Flight: **AC204** c. Take RBR **Photo**	
	* PRESS THE "FLIGHT ARRIVAL" BUTTON FOR FLIGHT AC204.
Step 4: Submit e-Dec Marie walks off the plane and can now press the "Submit" button on her e-Declaration.	
The MyTravel app notifies Marie that she has to go to a Primary kiosk for photo validation. However, Marie sees that her mobile phone is running out of power, so she finds an outlet in the wall somewhere in the Arrival zone and sits down next to it for an hour.... ...	
... ...	**Step 1: See Alert** The Orchestrator notifies Mobile Enforcement Command that "Marie Bennet" is a traveller who should be somewhere in the Primary zone. : **Step 2: Forward the Alert to Roving BSO** Jake Austen forwards the alert to BSO Andria Bingley.	
... ...		**Step 5: See the Alert** BSO Andria Bingley receives the alert on her watch and then reviews the traveller information on her mobile device.

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	Step 6: BSO Andria walks around the Primary zone looking for Marie Bennet. ... BSO Andria eventually finds Marie Bennet.
	Step 7: BSO Andria presses the "Engaged" button on her watch.
Marie Bennet hands her passport to BSO Andria.	Step 7: Scan traveller's passport BSO Andria talks to Marie Bennet. BSO Andria asks for Marie's passport and scans it with her mobile device. BSO Andria now reviews Marie's travel profile and information on her mobile device.
	Step 8: Override time alert BSO Andria overrides the time problem using her mobile device. BSO Andria tells Marie to present herself at a Primary kiosk as soon as possible.
Marie Bennet unplugs her mobile phone and walks towards a Primary kiosk.	Step 9: BSO Andria presses the "Roving" button on her watch.

Step 5: Primary Kiosk

Marie Bennet goes to kiosk #11 in the Primary zone. At the kiosk:

a. Scan the **picture page** of your **passport**
b. Scan **passport chip.** ↳ Close your passport and hold it next to the back of the kiosk (keep it still for 10 seconds as the reader tries to find the chip)
c. Take RBR **photo**

The MyTravel app notifies Marie that she can proceed to the Baggage Carousel zone to pick up her 2 bags.

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Step 6: Baggage Carousel Marie Bennet picks up her 2 bags.		
Step 7: Egress Marie enters Egress Lane #4.		
	Jonathan Darcy **(Egress Security Officer)**	
	Step 1: View Traveller State on Screen Jonathan Darcy sees on his screen that "Marie Bennet" is a who should have "2" piece of luggage. Jonathan Darcy decides to let Marie proceed.	
Marie enters Canada.		

Scenario #4

Ruth Organa	Luke Walker
(Canadian traveller)	**(Egress Security Officer)**

Step 1: Profile Creation
 	
Ruth Organa opens the MyTravel app and creates her profile:
 	
  a. User Email address
  b. PIN: **6666**
  c. Scan the **picture page** of your **passport** (make sure the bottom 2 lines of the page are in the scan window of the camera)
  d. Take **1 Profile photo** (your normal, relaxed face)
  e. Take **7 RBR photos** (various facial gestures)	

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Step 2: FAQ
Ruth has a question about duties and fees, so she opens the FAQ section of the MyTravel app and easily finds the answer.

Step 3: Request travel history
Ruth needs a copy of her travel history, so she goes to the Passage History section of the MyTravel app and requests it to be sent to her.

Step 4: Check In

Ruth Organa "Checks In" at the airport:
 	
  a. Scan the **picture page** of your **passport**.
  b. Flight: **AC336**
  c. Bags: **1**

⟹	* PRESS THE "FLIGHT DEPARTURE" BUTTON FOR FLIGHT AC336.

Step 5: Prepare e-Dec

In flight, Ruth prepares her e-Declaration:
 	
  a. Exemptions: **$0**
  b. Flight: **AC333 (an error)**
  c. Take RBR **Photo**

Step 6: Fix e-Dec
While in flight, Ruth remembers that she accidentally put the wrong Flight # in her e-Dec. So she opens the app, presses the "Home" button, and then re-does her e-Declaration (with the right Flight # this time!) Flight : **AC336**

⟹	* PRESS THE "FLIGHT ARRIVAL" BUTTON FOR FLIGHT AC336.

Step 7: Submit e-Dec
Ruth walks off the plane and can now press the "Submit" button for her e-Declaration.

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| |
The MyTravel app notifies Ruth that she has to go to Primary for photo validation.

Step 8: Primary Kiosk

Ruth Organa goes to kiosk #5 in the Primary zone. At the kiosk:

   a.   Scan the **picture page** of your **passport**
   b.   Scan **passport chip**.   ↳ Close your passport and hold it next to the back of the kiosk (keep it still for 10 seconds as the reader tries to find the chip)
   c.   Take RBR **photo**

The MyTravel app notifies Ruth that she can proceed to the Baggage Carousel zone to pick up her bag.

Step 9: Baggage Carousel

Ruth Organa picks up her bag.

Step 10: Egress

Ruth enters Egress Lane #7.

Step 1: View Traveller State on Screen

Luke Walker sees on his screen that "Ruth Organa" is a '   who should have "1" piece of luggage.

Luke Walker decides to let Marie proceed.

Ruth enters Canada.

2 Months Later...

The MyTravel app reminds Ruth that her passport is about to expire.

Ruth opens the My Travel app and spends a few moments completing her passport renewal application.

She:

   a.   Answers some standard **questions**
   b.   Takes a new passport **photo**
   c.   Pay with your fake credit card: **4111111111111111**

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She then presses the **submit** button.
The MyTravel app gives Ruth a **QR code** that she can present at a local passport office if there are any questions about her application.

Scenario #5

BSO Devin Kent & BSO Sylvie Prince (Roving BSOs)	Thérèse Wayne (Mobile Enforcement Command)	Jack Napier & Veronica Pennyworth & Peter E. Nigma (Travellers)
Step 1: Both BSOs sign into the Mobile Enforcement Command system.		**Step 1: Profile Creation**
	Step 1: Assign Roving BSOs to their Zones → Therese assigns BSO Devin to the Baggage Carousel zone. → Therese assigns BSO Sylvie to the Intermediate zone.	The travellers open the MyTravel app and create their profiles: a. User Email address b. PIN: 6666 c. Scan the picture page of your passport (make sure the bottom 2 lines of the page are in the scan window of the camera) d. Take 1 Profile photo (your normal, relaxed face) e. Take 7 RBR photos (various facial gestures)
Step 2: The BSOs tap "Roving" button on their watch		
Step 3: Walk to their zone		**International travellers:** If you have a non-Canadian passport, you will also have to do the eTA part of enrolment. f. Apply for **eTA** g. Pay with your fake credit card: **4111111111111111** The travellers are ready to fly!
Step 4: Check In to Zone On arrival, the BSOs "check in" to their zone using the mobile device.		

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...BSOs Roving!	**Step 2: Check In** The travellers "Check In" at the airport: a. Scan the picture page of your passport. b. Bags: 1 **Different Flight numbers:** - Jack Napier: **AC882** - Veronica Pennyworth: **AC919** - Peter E. Nigma: **AC314**
* PRESS THE "FLIGHT DEPARTURE" BUTTON FOR FLIGHTS AC882, AC919, and AC314. ...Roving!	
...Roving!	**Step 3: Prepare e-Dec** In flight, the travellers prepare their e-Declarations: a. **Exemptions: $0** b. Take **RBR Photo** **Different Flight numbers:** - Jack Napier: **AC882** - Veronica Pennyworth: **AC919** - Peter E. Nigma: **AC314**
* PRESS THE "FLIGHT ARRIVAL" BUTTON FOR FLIGHTS AC882, AC919, and AC314. ...Roving!	
...Roving!	**Step 4: Submit e-Dec** The travellers walk off the plane and can then press the "Submit" buttons on their e-Declarations.
	The MyTravel app notifies the travellers that they will have to go to a Primary kiosk for photo validation.

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Step 5: Primary Kiosk

TRAVELLER INSTRUCTIONS:

...Roving!

Jack Napier: Go to kiosk #13 in the Primary
zone. At the kiosk:

    a.   **Scan the** picture page **of your**
          passport
    b.   **Scan** passport chip.   ↳ Close
          your passport and hold it next to
          the back of the kiosk (keep it still
          for 10 seconds as the reader tries
          to find the chip)
    c.   **Take RBR** photo

Veronica Pennyworth: Wait for a while in the
Primary zone. You will have a "broken RBR" –
instructions will follow later in this script.

...Roving!

Peter E. Nigma: Just walk around the Arrival
Hall. Do not go to a kiosk.

	The MyTravel app notifies Jack Napier that he can proceed to the Baggage Carousel zone to pick up his suitcase.

BSO Devin (Baggage Carousel zone) sees Jack
Napier and is suspicious of him...

Step 5: BSO Brendan presses the **"Engaged"**
button on his watch and approaches Jack
Napier.

Step 6: Scan traveller's passport

BSO Devin asks for Jack Napier's passport and
scans it with his mobile device.

BSO Devin now reviews Jack's travel profile
and information on his mobile device. BSO

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Devin suspects that Jack is bringing drugs into Canada, so he says goodbye to Jack and then uses his mobile device BSO Devin can pick from a dropdown list of reasons for the referral. Jack Napier should now be diverted at Egress and sent to Secondary.	
Step 7: BSO Devin presses the "**Roving**" button on his watch.	
	Step 2: Re-Assign BSO Devin to the Primary Zones → Therese assigns BSO Devin to the Primary zone.
Step 8: BSO Devin acknowledges the re-assignment, and starts walking to Primary.	
Step 9: BSO Sylvie Prince sends out a Red Alert (call for help).	
Step 10: BSO Devin taps "**Responding**" on his watch and starts running towards BSO Sylvie. He finds her and helps her subdue a drunk traveller.	
Step 11: BSO Devin taps "**Roving**" and continues walking towards the Primary zone.	
Step 12: Check In to Primary Zone On arrival, BSO Devin "checks in" to the Primary zone using the mobile device.	**Veronica Pennyworth:** Go to kiosk #6 in the Primary zone. At the kiosk: a. **Scan the** picture page **of your** passport b. **Scan** passport chip. ↳ Close your passport and hold it next to the back of the kiosk. c. Take a "**bad**" **RBR** photo (ie. look down or have someone else take the photo – we need you to break the photo-matching system)

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	The bad/broken RBR issue should alert the Orchestrator of a problem. The Orchestrator will then forward the alert to the Mobile Enforcement Command.	
	Step 3: See Alert The Orchestrator notifies Mobile Enforcement Command that there is a problem verifying a traveller at kiosk # 6 in the Primary zone. **Step 4: Forward the Alert to Roving BSO** Therese Wayne forwards the alert to BSO Devin in the Primary zone.	
Step 13: See the Alert BSO Devin Kent receives the alert and walks to kiosk #6. **Step 14: BSO Devin** presses the "**Engaged**" button on his watch.		
Step 15: Scan passport BSO Devin scans Veronica Pennyworth's passport and reviews her travel profile and information on his mobile device.		
Step 16: Override RBR issue BSO Devin overrides the RBR problem using his mobile device.		**Veronica Pennyworth** can now continue with her Primary kiosk tasks.
Step 17: BSO Devin presses the "**Roving**" on his watch.		**Peter E Nigma** is walking around the Primary zone but has not gone to a kiosk yet.
	Step 5: See new alert Therese Wayne sees an alert from CBSA Targeting. There is a national security lookout for "Peter E. Nigma" – a traveller who has just flown in to the airport.	
	Step 6: Forward the Alert to ALL Roving BSOs Therese Wayne forwards the alert to all Roving BSOs in every zone.	

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Step 18: Review Alert info	
BSO Devin and BSO Sylvie review all the known information about the traveller. Then they keep roving while looking for the traveller.	
Step 19: Finding the traveller BSO Devin finds Peter E. Nigma in the Primary zone, so he **takes ownership of the alert** (which cancels it for BSO Sylvie).	
Step 20: BSO Devin presses the "**Engaged**" button on his watch and goes to talk to Peter E. Nigma.	

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Chain of Trust (CoT)
Exercise 4 - Outcomes and Notes

Date: March 27, 2018   Reference: CoT20180327

Exercise 4 Summary Report:

The Chain of Trust project completed Exercise 4 at the CBSA Science and Engineering facility from March 6th to 8th, 2018 (with two pre-exercise testing sessions held in the weeks beforehand). This was the fourth and final exercise planned for the Chain of Trust prototype project.

Exercise 4 featured several notable advancements from Exercise 3, which had been held in December 2017. Of note:

- the project team ran larger volumes of travellers through the system concurrently and assessed the outcomes;
- the project team tested indoor positional technology for the CBSA Mobile Enforcement app which could aid Roving Border Service Officers (BSOs) to localize each other within the airport;
- the IRCC and CBSA predictive analytics teams tested three new scenarios for collaboratively identifying high-risk travellers;
- IDENTOS collected usability feedback from the volunteer actors (both travellers and Roving BSOs).

As with previous exercises, the planning for the exercise consisted of bi-weekly teleconferences of micro-team leaders, to establish planning, brief on progress and collaborate on remaining challenges.

Exercise 4

The core systems for Chain of Trust had been developed and built in large part by the end of Exercise 3, and they continued to function as envisioned during Exercise 4. This allowed the project team to focus on other aspects, such as increasing the volume of the testers, assessing additional scenario cases not previously covered, and gathering usability feedback from the testers.

To assess the system's handling of larger volumes of travellers, approximately 15 CBSA volunteers were engaged to play the role of travellers moving through the system at the same time. This testing was conducted during the full day of March 6th and the morning of March 7th. Despite a few problems, such as issues with bandwidth and messaging, the system generally performed as expected.

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On the afternoon of March 7th, 2018, a demonstration of the system was provided for IRCC senior management, including several directors, as well as the Director General of IRCC's Operations, Performance and Planning Branch, and its Assistant Deputy Minister Operations.

The final day of the exercise, March 8th, consisted of a project wrap-up discussion – assessing progress and remaining challenges, and discussing next steps and the project close out. A summary of this discussion is provided below:

- Progress:
  - The project team noted that the modular sub-systems within Chain of Trust (largely "plug and play") really allows for flexibility in terms of further development. The team is very happy with how well this has worked out.
  - The Mobile Enforcement app and smart watch were very well received by testers.
  - The use of predictive analytics was more clearly identified in this exercise thanks to new scenarios and additional displays showing the back-end risk scores.
- Challenges:

  - It was noted during discussion that additional diagnostic interfaces would have been useful for troubleshooting the Orchestrator.
  - It was noted that the user experience feedback may be somewhat biased due to the step-by-step instructions that were provided to the travellers early each morning. However, these instructions were ultimately the fastest way to get the testers on the floor.
- Next Steps:
  - Mike Haymes and Naomi Barrett will write the Exercise 4 report and distribute to the project team for review.
  - Partner contracts are currently being amended to end on March 31st, 2019 in order to include one year of prototype demonstrations.
- Project Close:
  - IRCC will write the project close out documentation for CSSP.
  - Project partners must all submit their final reports to Naomi Barrett by March 25th, 2018.

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Usability Testing

Usability assessment played a prominent role in Exercise 4. Chain of Trust engaged IDENTOS to provide an assessment of the usability feedback collected from volunteer testers and BSOs during Exercise 4. With the aim of capturing the widest range of feedback possible, the usability testing took place in two parts:

- **Observation and interacting with testers as they moved through the system:** Several project team members were assigned to move among the travellers and Roving BSOs during Exercise 4 with the aim of identifying and capturing the issues that troubled or confused the testers. These note-takers wrote down any thoughts from the testers (miscommunications, room for improvement, tips, etc) as they occurred.
- **Tester surveys:** At the end of each testing day, each tester was asked to complete a user survey designed to help the project team understand overall satisfaction, and point out places where the testers identified room for improvement.

While this strategy worked reasonably well, there were some concerns about providing step-by-step instructions to the testers as a potential source of bias for the feedback received.

Initial recommendations/observations from the usability assessment include:

- Both travellers and BSOs expressed appreciation for how the apps could make their lives easier in the future.
- Ensure travellers and BSOs have a clear view of where they are in any process. Travellers sometimes lost track of what they needed to do and when (e.g., to submit their e-Declaration upon arrival). BSOs were unsure whether their actions actually took effect.
- Clarify messaging. Ensure messaging is written to be readable by the uninitiated; replacing jargon and acronyms with more meaningful copy, even if it's longer, or ensuring that the phrases used match their real-world context. Adjusting the messaging can help users make decisions and take actions with confidence.
- Importance of ensuring the needs of users are met, as opposed to simply ensuring all components can successfully communicate with each other. Especially in the case of BSOs, whose needs for use weren't fully met by the existing app.

As a next step, IDENTOS will synthesize feedback from the user surveys and note-takers and compile usability recommendations for the project. These recommendations will be made available in the final report from IDENTOS.

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Micro-Team reports: Observations and notes from Exercise 4

To support this report, each micro-team leader was asked to provide notes from Exercise 4 on their subsystem - explaining which pieces worked, where they experienced challenges, and describing opportunities for further development of their subsystems. Summaries of these notes are provided below:

> ### TRAVELLER MOBILE APP ("MY TRAVEL" APP):

A majority of the effort since the previous exercise focused on refinement and completion of communications with other system components. The creation of distinct development environments in the AWS Cloud in January had allowed all partners to work on their system components while maintaining a clean demo environment that was available to show at any time.

As a result of the efforts since Exercise 3, the fourth exercise saw data flowing between each component system without the need for stubs or hard coding, which was one of the key objectives of the project.

A newer model of IRCC Predictive Analytics was integrated with the MyTravel service. This allowed scenarios to be tested with travellers fitting certain profiles to trigger various scores that fed into the Orchestrator and could flag them for Mobile Enforcement upon arrival.

The final exercise highlighted some areas where more fine-tuning of the MyTravel app would be needed, such as:
- Notifications to the traveller: Need to ensure it is clear whether the traveller is to take an action as a result of the message or if it is for information purposes only.
- More information about the outcomes and instructions – make it more intuitive.
- The travellers didn't seem to like taking selfies. There is a need to find a way to get photos of the traveller (as required for the Renewable Biometric Reference) that does not involve the traveller taking selfies (e.g. video).

There are also some places in the flow where dependencies ought to be strengthened. For example, the MyTravel app allows travellers to submit their e-Declaration upon arrival, but there is currently nothing that keeps them from going through egress without submitting it. This resulted in some of the system messaging –Orchestrator, Flow Control and MyTravel – to be out of sequence.

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Sequencing and receipt of messages between the component systems was an area that would require further analysis and testing as there were issues with lags when there were larger number of travellers. Network configuration has already been identified as a first area to address.

➤ KIOSKS (CHECK-IN, PRIMARY & INTERMEDIATE)

The functionality kiosk didn't change significantly from Exercise 3 although there were a few modifications:

- the Check-In kiosk added an additional line for number of travellers.

A gap was identified when travellers at the Primary kiosk fail to complete their task properly (whether user error or system error). The kiosk tells the traveller that a BSO will come to assist them momentarily, however there is no mechanism currently in place that communicates this to Mobile Enforcement Command.

➤ CBSA MOBILE ENFORCEMENT APP AND DISPATCH SYSTEM

Overall, the CBSA Mobile Enforcement app and dispatch systems worked as expected. Several new advancements were incorporated and tested during Exercise 4.

Bluetooth beacons were installed in the "airport" to test a new feature of the Mobile Enforcement app: officer localization within the arrivals hall. Testers reacted positively to the idea. However, there were some challenges relating to the API for the Bluetooth beacons, which weren't fully exposed for Android (the iOS API seemed to have more capabilities).

A traveller image was also added to the smart watch which would allow Roving BSOs to visually identify a traveller who requires intervention. However, network issues sometimes precented the sending and receiving of messages from the Orchestrator.

One area that had been discussed by the project team, but was ultimately not incorporated into the project was the deployment of Google Glass for the Roving BSOs. This was not included due to limited support and documentation for the technology. Further research into heads-up displays will continue.

Overall, discussions around the Mobile Enforcement app and smart watch were very positive. In fact, there was some talk about using the smart watch even more in order to allow the BSOs to be hands-

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free. In regards to the app on the smart phone, there were some discussions about traveller data privacy and ways to prevent others from seeing the information that a BSO is viewing on the screen.

There was also some discussion around identifying what information is the most pertinent to display on the Mobile Enforcement Command screen, and what information could be hidden.

> ### RENEWABLE BIOMETRIC REFERENCE (RBR)

All components for the RBR were complete and working for Exercise 4. The RBR server was up and running, which can automatically generate a client's RBR, verify an RBR, and generate and verify the e-declaration "biometric signature." The service had no problem with the increased load of travellers during the exercise.

A slightly higher strictness of matching algorithm was used than for Exercise 3. During the exercise, some travellers failed their RBR validations multiple times due to not having enough variability in their selfies. It was shown that it is important that the users are aware that they need to have variability in their selfies, for example, by singing or talking while taking the selfies. The more uniform lighting during the exercise helped for the accuracy of the RBR.

> ### ORCHESTRATOR

In general, the Orchestrator performed well in Exercise 4. New user displays were added that identified traveller risk scores as they passed through the system. This proved very valuable in demonstrating the back-end risk assessment taking place throughout the travel continuum.

New rules were added to handle travellers with high-risk, as assessed by predictive analytics. These rules would flag travellers who's risk scores exceeded a particular threshold and send these flags to the Mobile Enforcement Command for review.

As with Exercise 3, the Orchestrator had some issues with message lag and the message order being mixed up, possibly tied to bandwidth limitations in the testing environment. These issues caused significant problems for the sub-systems depending on the Orchestrator and demonstrated the critical importance of message timing and Orchestrator dependability.

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Some additional areas for possible improvement were noted:
-   It was noted that additional diagnostic interfaces would have been useful for troubleshooting the Orchestrator.
-   CBSA staff noted that they would like the ability to change/add policies to the logic depending on location (eg. airport superintendant could experiment with changing the thresholds for Secondary referrals). The ability to simulate the effect of the policy changes and examining the data (based on the past traveller data at their airport) would be hugely beneficial.

> **IRCC PREDICTIVE ANALYTICS**

In past scenarios, a simple dummy script had been used to demonstrate the flow of information, with a separate unconnected laptop available to demonstrate the machine-learning scoring model built for the project. For Exercise 4, IRCC Predictive Analytics deployed a predictive analytics scoring model to the back-end of the WorldReach mobile application, enabling scoring of eTA travellers within the general dataflow.

The scoring and communication functioned as expected. High-risk travellers were given high scores by the IRCC model and were subsequently flagged by the Orchestrator for BSO intervention.

There were some issues in the deployment of the scoring script to the WorldReach server.

In the project wrap-up meeting, there was some discussion about the best way to provide risk scores to human officers without creating information overload or potentially biasing their judgement. If the model could also provide additional information about why a person scores high, this would be useful to human officers.

> **CBSA PREDICTIVE ANALYTICS**

To demonstrate the use of predictive analytics within the chain of trust system, the CBSA PA engine was configured and trained to score scenarios to trigger t   Orchestrator rules.

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The CBSA predictive analytics believes that additional opportunities could be included in Chain of Trust in the future, such as:

- including a graphical user interface that can interact with BSOs to translate human heuristics to machine configurable heuristic;
- refining the system to periodically update the model, taking historical data transactions as an input and delivering updated and refined model parameters as the output.

➢ **FACE RECOGNITION/TRAVELER FLOW**

Flow Control Lanes worked at a proof of concept level both on its own and when integrated with Chain of Trust system.

There were some issues relating to delayed messages from the Orchestrator, in some cases minutes after they were sent. Some faces were not detected in the lane.

Several advancements were completed for Exercise 4, including:
- New interfaces to Orchestrator (Minio)
- Re-architected to have Centralized FFS database for all lanes and separate lane controllers
- Optimized state machine
- Auto-reset for each lane so if there is an issue with use of the lane, lane will reset to normal state (this is to facilitate demonstration when complete system is not in place)
- Adjustments to UX based on feedback from Exercise 3.

Although not in the initial scope, additional flow control lane performance testing was planned following the completion of Exercise 4. This will use volunteers to assess the quality of face recognition performance and lane transit times. CBSA was not able to integrate a new match server for BSOs.

The issue of what to do in the event of a missed face-capture was also discussed as part of the exercise wrap-up.

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➢ **PASSPORT RENEWAL APPLICATION**

A mobile passport renewal app, built by WorldReach under Chain of Trust
                        streamline the passport renewal process, was also demonstrated as part of
Exercise 4. The app was built on the technology developed as part of the CSSP-funded Faster PrivBio
project. Discussion is ongoing about whether the photos taken by mobile phones are capable of meeting
ICAO specs for the purposes of inserting on a passport. A copy of the app was provided to IRCC for in-
house demo purposes and the app was included as part of the Chain of Trust demo given to IRCC senior
management during Exercise 4.

Further Testing and Demonstration

Although system development has completed, CBSA has arranged to maintain the dedicated project
space at 79 Bentley Avenue in Ottawa for a one-year period post-project to allow for further
demonstration and internal testing by CBSA. Project partners have agreed to provide a technology
training session on their individual portions of the project to enable CBSA staff to effectively use the
technology. The testing is expected to be valuable for CBSA in their strategic visioning exercises over the
coming year.

CBSA is working out details relating to how any future demonstrations would be delivered following the
completion of the Fiscal Year.

CHAIN OF TRUST : COLLABORATIVE RISK ASSESSMENT FOR AIR TRAVELLER PROGRAMS – Concept of Operations

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Speaker: Stephanie Kirkland

Predictive analytics have **proven value** in private industry and government

Predictive Analytics are **a key piece of the modernization strategy**
DPAT is working closely with partners: SPO, PID, CPR, IR and OMC

CIC is at the very beginning of using predictive analytics
We are catching up on other countries (USA and Australia for example) and other departments

Expectations need to be set carefully
Predictive analytics can be transformative for an organization,
but it takes a long time to put everything in place

Predictive Analytics – Overview

- What is predictive analytics
- Predictive analytics at CIC
- Why is Predictive analytics important for CIC
- Why Predictive Analytics in Operations
- Engagement of Key Stakeholders
- Predictive Analytics and Policy sector
- Projects update
- Example-Predictive Analytics Draft Model for VR-extension
- DPAT - Next steps
- Annex1: Predictive Analytics Approach and Method
- Annex2: Data and Predictive Analytics Roadmap
- Annex3: Key steps for Success

Speaker: Stephanie Kirkland

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Speaker: Stephanie Kirkland

Explains definition and how it works. Also talk about concrete benefits in any business doing predictive analytics (Walmart, for example, or Google, that both use that now in their business to save money, profile their consumers and improve resource allocations)

The benefits of combining operations expertise with empirical data and statistical analysis to build a predictive model:

*

* Increasing processing capacity

*

* Facilitate program integrity exercises
* Deliver optimal client service

Forecasting vs Predictive analytics:

How will predictive analytics help to detect fraud?:

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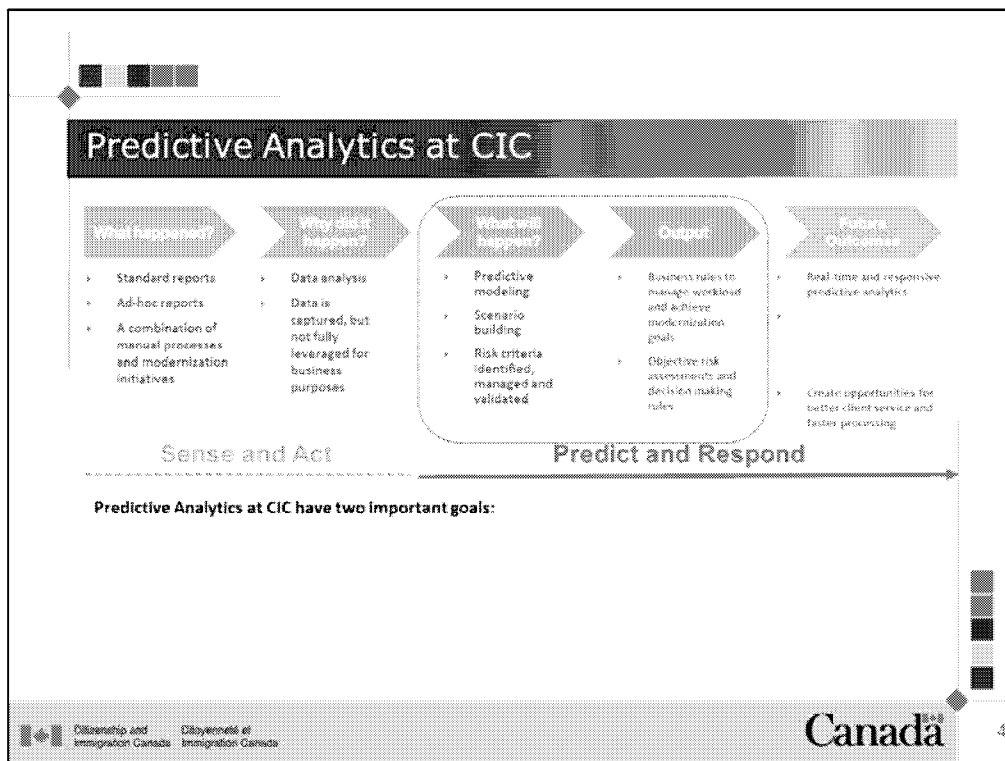
Speaker: Stephanie Kirkland

1. **Enable CIC's modernization agenda:**

   •

   •

   • By reducing the labor intensity of application triaging and processing as well as minimize the time to a decision for a significant number of cases.

   •

2. **Help to detect and reduce fraud and contribute to program integrity**

Predictive Analytics at CIC have two important goals:

1.

2.

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Why is predictive analytics important for CIC?

Predictive analytics at CIC will:

1. Enable CIC's modernization agenda

2. Help to detect and reduce fraud and contribute to program integrity

3. Contribute to long-term program evaluation and to better facilitate policy development.

4. Help CIC to cope with increased volume of applications

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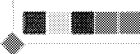
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Speaker: Stephanie Kirkland

Predictive Analytics in Operations

1. **Lead: OPMB- PMU**
   - Established expertise and experience in Business Intelligence (BI) providing deep, sophisticated analytics on large volumes of actual and historical data.
   - **Network wide experience in workload distribution** in collaboration with the network and sector.
   -
   -
   - OPMB is the lead for Data Governance in the department, in partnership with R&E.

2. **Key partners and clients:**
   - OMC : Program expertise (TRPD, PRPD) and program integrity (PID)
   - SPO : Project leads and clients
   - CPR (including regions when needed) and IR: Experts in processing and subject matter experts for intelligence gathering
   - SIMB: support IT systems and data
   - Other departments and jurisdictions: for lessons learned, best practices and information sharing.

Canada   6

Speaker: Stephanie Kirkland

Speaker: Marie-Josee Dorion

> ## Our stakeholder engagement* is three folded:

1.Bi-weekly working group meetings with partners
_ Every DPAT project (models) starts with a clear definition of business goals and a partnership is formed with the line of business
_DPAT Discuss findings with the business on regular basis for validation and to combine qualitative business knowledge with empirical statistical research

2. Stakeholder engagement sessions
_bi-monthly stakeholder engagement sessions to discuss findings with the business on regular basis for validation and to combine qualitative business knowledge with empirical statistical research
_Program experts, policy and administrative teams need to be involved to ensure successful project delivery

3. Engagement and sharing best practices with other departments and other countries;
_Held numerous meeting with CBSA
_Initiated a collaborative effort with other government departments and chairs a Data Analytics Coalition with key government departments and agencies

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Predictive Analytics and Policy Sector

- Predictive Analytics can support a specific decision task or policy by analysing historical data and identify meaningful patterns

-

Contributions from the Policy Sector to Predictive Analytics:

- Provides input, guidance and support to senior management on the development of a robust predictive analytics models
- Provides support to senior management participation in various consultations committees and working groups
- Provides regulatory and analytical policy advice and support
- Challenges the predictive analytics approach in the pursuit of rigour and integrity

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Speaker: Marie-Josee

1- Express Entry:

1- Express Entry-phase 1: COMPLETED
•DPAT developed models for FSW, CEC and PN and delivered Business rules for launch of Express Entry

•DPAT is working with CPR and Ops to use the business rules a level deeper by using GCMS Answers to create dashboards that will allow applications to be grouped and assigned, using the dashboard.

2- Express Entry-phase 2: will start in a few months
•DPAT is now waiting for few months to collect real data and validate or re-built the models developed based on proxy data. Once the data is available, Express Entry phase-2 will start in June 2015.

•Express Entry auto-triaging model will be deployed in spring 2016.

2.   eTA phase-2: will be starting in Oct 2015 (or even later now, with the new date)

–

–

1.TR Pilot: for deployment in the Spring/ June 2016.
    1.1. ICE
    IEC Working Groups held with stakeholders and draft model and GCMS
    Answers case-statements was delivered to OSC. Currently participating in
    INP IEC Phase 1 implementation (the digitization of IEC).
    DPAT will rebuild the model just prior to launching the Phase 2 pilot in
    2016.

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1.2. VR-Extension

VR-extension project started in Dec 2014 and is finalized in February 2015.
DPAT delivered Predictive Analytics Model to SPO and OPS.

1.3. STUDENT

_DPAT is starting the working groups with stakeholders to develop predictive model for auto-triaging

2.Full TR

TRV and TFW (including LCP)

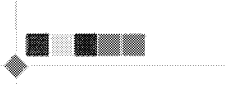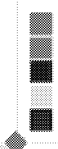_DPAT will start the working groups with stakeholders to develop predictive models in Spring 2015

Speaker: Marie-Josee

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EXAMPLE : Predictive Analytics draft model for VR-extension

Speaker: Marie-Josee Dorion

DPAT – Next Steps

- **Deliver on Projects**
  - a) IN Project
    - TR Pilot
    - FULL TR
  - b) Express Entry –Phase 2
  - c) eTA –phase 2

- **Monitor and improve models (including QA and QC of performance of models)**

- **Continue Stakeholder engagement and outreach**

- **Consult and agree on model governance**

- **Develop IT solutions**

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Speaker: Stephanie

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Speaker : SK or MJ

OF NOTE : THIS IS AN ITIRATIVE PROCESS, where we can go through steps one time, but we can also go between steps and come back if needed.

The Predictive Analytics approach and methods is based on the CRISP-DM phases.

CRISP-DM breaks the process of data mining into six major phases (and we have developed and agreed on a 7 step process)

1- Business Understanding : This initial phase focuses on understanding the project objectives and requirements from a business perspective, and then converting this knowledge into a data mining problem definition, and a preliminary plan designed to achieve the objectives.

2- Data Understanding: The data understanding phase starts with an initial data collection and proceeds with activities in order to get familiar with the data, to identify data quality problems, to discover first insights into the data, or to detect interesting subsets to form hypotheses for hidden information.
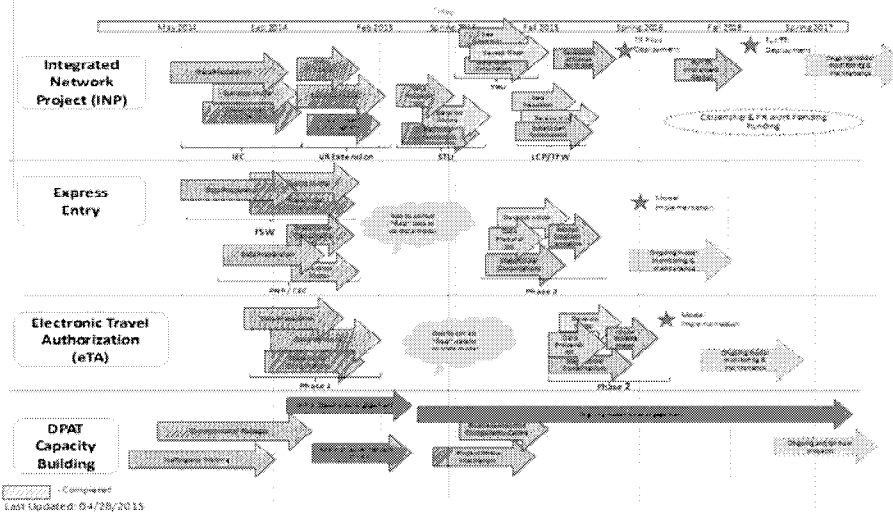
3-Data Preparation: The data preparation phase covers all activities to construct the final dataset (data that will be fed into the modeling tool(s)) from the initial raw data. Data preparation tasks are likely to be performed multiple times, and not in any prescribed order. Tasks include table, record, and attribute selection as well as transformation and cleaning of data for modeling tools.

4- Modeling: In this phase, various modeling techniques are selected and applied, and their parameters are calibrated to optimal values. Typically, there are several techniques for the same data mining problem type. Some techniques have specific requirements on the form of data. Therefore, stepping back to the data preparation phase is often needed.

5- Evaluation: At this stage in the project you have built a model (or models) that appears to have high quality, from a data analysis perspective. Before proceeding to final deployment of the model, it is important to more thoroughly evaluate the model, and review the steps executed to construct the model, to be certain it properly achieves the business objectives. A key objective is to determine if there is some important business issue that has not been sufficiently considered. At the end of this phase, a decision on the use of the data mining results should be reached.

6-Deployment: Creation of the model is generally not the end of the project. Even if the purpose of the model is to increase knowledge of the data, the knowledge gained will need to be organized and presented in a way that the customer can use it. Depending on the requirements, the deployment phase can be as simple as generating a report or as complex as implementing a repeatable data scoring (e.g. segment allocation) or data mining process. In many cases it will be the customer, not the data analyst, who will carry out the deployment steps. Even if the analyst deploys the model it is important for the customer to understand up front the actions which will need to be carried out in order to actually make use of the created models.

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Annex 2: Data and Predictive Analytics Road Map

Annex 3: Key Steps for Success

Key Steps to Success with Predictive Analytics

- Simplify the concept of predictive analytics for business users and managers.
- Executive sponsorship for predictive analytics projects
- A consistent process for collaborating with the business stakeholders
- Specific business outcomes for predictive analytics work
- Adequate IT support
- Proper communication of the results of predictive modeling to business stakeholders
- Having timely insights from predictive models in front of the business staff that can best use them
- A closed-loop feedback process for improving and updating predictive models.
- Executive endorsement of the results and for data driven decision making
- A center of excellence for data and predictive analytics

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Speaker : SK or MJ

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Lead Group

- Programs, Operational Management and Coordination

Key Supporting Groups in CIC

- Solutions and Information Management Branch
- Program Integrity Division, Operational Management and Coordination
- International, Central Processing, and Domestic Regions
- Strategic Projects Office
- Data and Predictive Analytics Unit, Operational Performance Management Branch

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Predictive Analytics

Predictive analytics describes the process of discovering patterns in past behavior to predict the outcome of future events. It combines computer science, statistics and operations research to drive smarter decisions by extracting actionable insights from vast quantities of data.

Timelines, Milestones, and Dependencies

- Models for Automated triaging and auto-assignment of Express Entry applications for Fall 2015 for Phase 2 of modeling (working with real express entry data), for a roll out of a Predictive Analytics model in late spring 2016

- Business rules for triaging of eTA applications developed in February 2015 (phase 1 of the eTA work).

-

-

Operational implementation of the models is critically dependent upon integrating the team's work with that of SIMB, as data exchange with GCMS is crucial to apply the models to applications in progress.

Level of Effort
Moderate –

A significant amount of work has been undertaken to acquire the necessary software tools and develop internal expertise.

Lead Group

- Data and Predictive Analytics Unit, Operational Performance Management Branch

Key Supporting Groups in CIC

- Solutions and Information Management Branch
- Programs, Operational Management and Coordination
- Program Integrity Division, Operational Management and Coordination
- International, Central Processing, and Domestic Regions
- Strategic Projects Office
- Performance Management Unit, Operational Performance Management Branch

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Risk Tiering

Risk tiering is a systematic approach to processing cases based on their likely level of complexity. When risk tiering, individual cases are assessed for their level of complexity using a checklist of individual triage criteria, which typically vary by line of business. Triage criteria are risk indicators which have been demonstrated to be useful in differentiating between aspects of complex and non-complex cases. Once a case's level of complexity has been assessed it is then assigned to an appropriate decision maker for processing.

Timelines, Milestones, and Dependencies

Level of Effort

– Development of effective risk tiering is dependent upon the development and validation of effective risk indicators and triage criteria,

. Risk tiering rules must also be monitored and validated on a consistent basis to ensure that they work as designed, both when they are first implemented and as operational conditions evolve over time.

Options for a Predictive Analytics Pilot

Operations Planning and Performance Branch

November 23, 2016

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Predictive Analytics Projects Underway

- Field trial of China TRV model

- Risk triage for In-Canada Spousal Inventory Reduction

-

- Risk triage models for Express Entry

- Risk indicators for Passport identity fraud

- Risk indicators for eTA

- Risk indicators for citizenship fraud

- Medical assessment targeting

- Biometric queries targeting

Maturity Scale

Ready for pilot

In development

Initial scoping
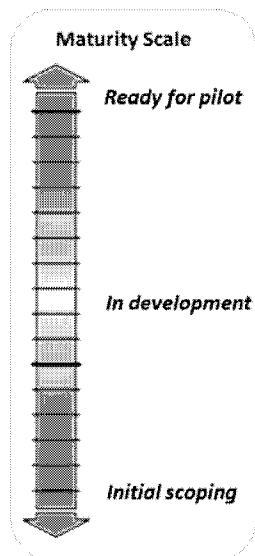
Progress has been made in designing IT infrastructure for deploying models

- Since Spring 2016, OPPB has been working with SIMB to design the IT infrastructure required to deploy a predictive model.

- The detailed business requirements were completed in September 2016.

- SIMB will soon begin designing the system.

- Once this work is completed, SIMB will have a blueprint of how to build and maintain the system.

- In the meantime, pilot projects can be used to test the performance of models in the real world.

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Two pilot projects already in progress

China TRVs

Family class spousal sponsorships

- In June 2016, predictive models were used to perform a risk triage of the entire in-Canada spousal inventory.

- Each application was assigned a rating of high, medium or low risk, to assist officers when deciding how much scrutiny may be required.

- Among finalized applications since June, those that were identified as low risk had a refusal rate of just 4.7%, while high-risk cases had a refusal rate of 24.6% (overall refusal rate is 9%).

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Options for another pilot

The following slides present seven options for an additional low-risk pilot. They are ranked by the degree of readiness to proceed with a pilot in the near term.

1.

2.

3.

4.

5.   Enhance risk triage for Federal Skilled Workers.

6.   Improve risk triage of Citizenship Grants.

7.   Improve targeting of medical assessments for TRs.

Other future applications under consideration include:

- Optimizing the management of the ATIP workload.

- Enhanced client service through the Call Centre.

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Advantages

- **Streamlined processing** with high accuracy.

-

- **Model will have already been validated** in the field.

-

Drawbacks

- **Resource constraints at EDW** mean that:

  - OPPB would have to fund a consultant for them ($50K).

  - Project delays could occur.

Timeline: Early 2017-18.

Costs: About $50K in consulting fees for EDW in 2016-17. OPPB has the money.

Next steps:
- Await results of field trial of the model.
- Conduct additional field trials, if deemed necessary.
- Work with CN, IN and EDW to develop the tool.

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Advantages	Drawback
• • **Low risk clientele** which has been approved recently. • **Simple process** makes it easier for a model (e.g., no supporting documents).	• **Overlap with CN's existing business rules:** CN's rules are very good; incremental efficiency gains may not be large enough to justify the additional effort.

Timeline: Early 2017-18.

Costs: Manageable within existing budgets.

Next steps:
- Assess overlap between predictive model recommendations and existing business rules.
- Refine existing model.
- Conduct a field trial.

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Advantages	Drawbacks
• **Streamlined processing** for a program with considerable volume. • **Low risk clientele.** •	• • **Uneven eligibility requirements**: eligibility criteria and documentation requirements vary by country, making it difficult to build a general-purpose model. Might require multiple models.

Timeline: Early 2017-18.

Costs: Manageable within existing budgets.

Next steps:
• Develop and test one or more models.
• Conduct a field trial.

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Advantages	Drawbacks
• **Streamlined processing** with high accuracy. Model simulations show promise. •	• • **Buy-in from line of business**: Unclear if this is a priority or if resources are available.

Timeline: Early 2017-18.

Costs: Manageable within existing budgets.

Next steps:
• Seek buy-in from line of business.
• Refine model.
• Conduct a field trial.

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5. Enhance risk triage for Federal Skilled Workers

Advantages

* **Possibly some improvement in accuracy** relative to the current risk triage process.

* **Link to MYLP:** FSW are an important source of projected growth in levels.

* **Express Entry keeps changing**, making it harder to develop an accurate model.

Timeline: Early 2017-18

Costs: Manageable within existing budgets.

Next steps:
* Assess the impact of recent changes to Express Entry on the existing model for FSW.
* Refine model.
* Conduct field trial.

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6. Improve risk triage of Citizenship Grants

Advantages
- **Supports our response to Auditor General's concerns.**
- **Efficiency gains:** Streamlined processing for low-risk clients could help manage pressures resulting from shorter residence requirements (Bill C-6).
- **Buy-in from the business:** support from CPPG, PIB, CMB, CN and DN.

Drawbacks
- **Data require cleaning:** past applications are a combination of "legacy" and "new build".
- **Low rate of fraud detection in the past** makes it difficult for a model to "learn" to recognize fraud.

Timeline: Middle of 2017-18

Costs: Manageable within existing budgets.

Next steps:
- Continue cleaning the data.
- Begin developing a model.
- Conduct a field trial.

7. Improve targeting of medical assessments for TRs

For TRs, the decision on whether a medical assessments is necessary hinges on regulations which may not be rooted in strong evidence.

Advantages	Drawbacks
• **Improved targeting of health threats.** • **Faster processing** for low-risk clients. • **Buy-in from line of business**: Migration Health Branch is eager to collaborate.	• **Resource constraints** at Migration Health Branch would push the start of this project into 2017-18. • **New subject area** for OPPB means a steeper learning curve, a longer model development period, and greater uncertainty of results.

Timeline: By end of 2017-18.

Costs: Likely manageable within existing budgets.

Next steps:
- Gain a deeper understanding of the medical assessment process.
- Gather available data.
- Develop and test a model.
- Conduct a field trial.

Next steps after selecting an option

- Work closely with affected branches, especially PIB, to:
    - Refine the scope of the pilot.
    - Inform model development.
    - Ensure program integrity safeguards and risk mitigation.
    - Define *ex post* quality assurance activities and reporting.

- Develop a governance framework for predictive models and risk indicators.

- Ensure ongoing communications with other branches on plans and priorities.

Annexes

s.16(1)(b)

s.16(2)

Value Proposition of Predictive Analytics

- Risk management is built into the process by design.

- Generates useful knowledge for program re-design in the longer term.

Difference Between Business Rules and Predictive Analytics

While business rules and predictive analytics have some similarities, they are **not** one and the same.

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Pros and Cons of Predictive Analytics Compared to Business Rules

Advantages	Drawbacks

• **Exhaustive.** Models consider how all available information correlates with the outcome. Business rules are limited by our imagination.
 	
 • **Granularity.** Models create rules with many conditions that target very similar cases.
 	
 • **Flexibility.** Business rules that are hard-coded into a system cannot be updated regularly; models can be updated more easily.
 	
 • **Informative.** Models use probability scores to specify each the degree of risk, rather than just a "pass" or "fail".
	• **More complex.** Predictive analytics requires specialized skills and software.
	
	 • **Higher upfront cost.** Models take more time and resources to create and deploy. *However:*
	
	   – *IT infrastructure required for predictive models has large economies of scale and can be easily replicated across lines of business with smaller incremental costs.*
	
	   – *Models detect higher volumes of low- or high-risk cases, which generates efficiencies to recover the upfront costs over time.*

Ravi:
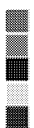
The purpose of this presentation is to provide an update on the development of Program Risk Indicators and associated triage criteria which will support the implementation of Express Entry

This work in being done by OMC – Permanent Resident Program Delivery (PRPD), OMC – Program Integrity Division (PID) and OPMB Data and Predictive Analytics Team (DPAT)

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Overview

1. Overview of CIC triage development
2. Phased development of Express Entry triage criteria and workload distribution
   1. Phase 1 – Launch of Express Entry
   2. Phase 2 – Fall 2015
3. Next Steps

Canada
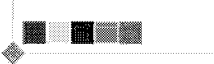
Ravi: See slide, no further details to add for speaking points.

Overview of CIC triage development

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Immigration Canada   Immigration Canada

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David:

Express Entry Application Triage is a Phased Approach

- Criteria to triage Federal Skilled Work (FSW) applications under Express Entry is being developed in phases to flexibly respond to the known and unknown demands of the new system:

  - **Triage Phase 1**:Launch of Express Entry (January 1st, 2015)
    - "Manual" approach (similar to existing approach with paper applications)
  - **Triage Phase 2**: Fall 2015
    - Automated triage and scoring based on predictive analytical modelling layered with business rules and workload distribution models

- As the majority of Canadian Experience Class (CEC), Federal Skilled Trades Program (FSTP) and Provincial Nominee Program (PNP) applications are already processed in Canada, development of application triage instructions is not required for Triage Phase 1, but are being examined for Triage Phase 2.

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Ravi:

More details on each phase will be provided in subsequent slides, this is just the overview slide. Please use bullets as speaking points.

Express Entry Triage Phase 1: "Manual" Approach

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David:

issued an ITA.

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Evolution of Express Entry Triaging of cases and workload distribution

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Ravi :
Point 1: MJ can jump in for tech related questions.

Point 2:
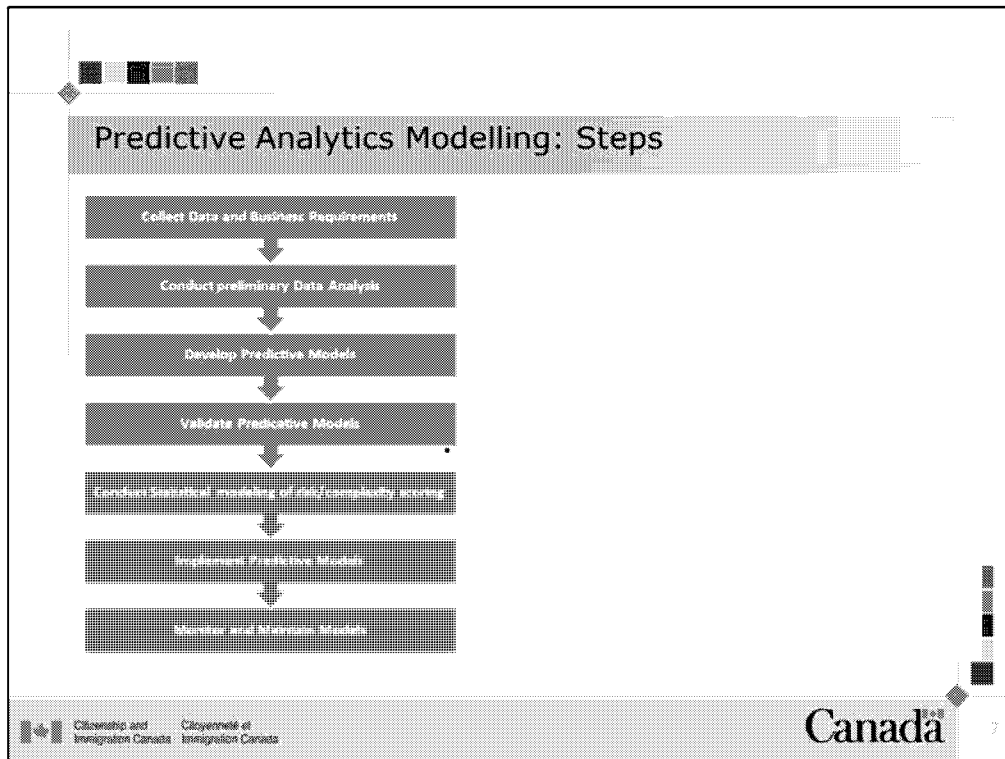
Marie-Josée:

Links with previous slide : Before we go in the results and the details, a few words on what this is that we do in predictive analytics.

To achieve automated triaging and to develop and implement evidence-based & quantitative triage rules, OPMB-DPAT has worked with:
-Partners and clients:
        -OPS partners, such as OPMB-PMU, OMC-PRPD, OMC-PID, IR, CPR, and SPO.

-Historical data:
FSW:
Total number of valid records consist of 155,665 applications
Total number of **fields** is **122** unique fields
Dates covered (final decision dates) are from **2007-01-01** to **2008-02-27**

PN:
Total number of valid records consist of 111,060 applications
Total number of **fields** is **122** unique fields
Dates covered (final decision dates) are from **2007-01-02** to **2014-08-18**

CEC:
Total number of valid records consist of 25,058 applications (GCMS only)
Total number of **fields** is **122** unique fields
Dates covered (final decision dates) are from **2011-07-16** to **2014-08-15**

Note: The goal is to "automate" risk tiering and auto-triaging

Triaging Rules for Express Entry

- Business rules were developed by the model for possible auto-triaging and auto-assignment.
- These rules were presented as **If ...Then...** statements that can be imposed on upcoming applications for triaging.

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CEC Predictive Dashboard

- CEC dashboard was prepared by DMT and DPAT to test business rules provided by the model for possible auto-triaging and auto-assignment.

-

Columns
Click on column names in the selection pane to add them to the request

Appli⬤cation Number   Tr①e Rules   Applicat⑤Assessments
Application Number   Triage Rules   Final Assessment

[Display Results] [Remove All]

④

Filters
Add filters to the request criteria by holding down the CTRL key and clicking on column names in the

Application Category is equal to / is in CEC   ③
AND Final Assessment Date is between 16/07/2011 and 15/08/2014
AND Final Assessment is equal to / is in Approved, Refused

[Save Filter...] [Remove Filters]

[Combine with Similar Request]

① Custom column based on series of case statements used to develop triage rules

②
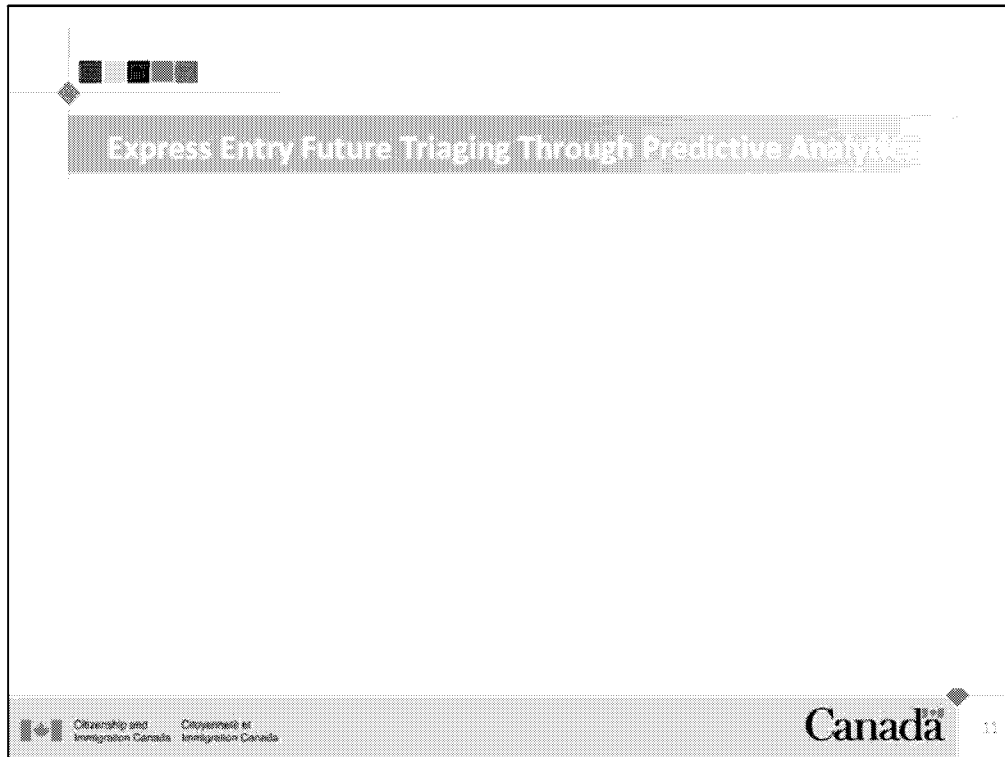
③ Report filters applied to report

④ The Edit Formula button allows the report creator change the column heading and the formula for the column.

⑤ Example of available columns from the selection pane which can be included to customize report

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Accuracy of SPSS Triage Rules Outcome vs. GCMS

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Scores and models are not everything: other rules in GCMS will be combined with the SPSS models scores so that triaging is automated and as accurate as possible.
The placement of the business rules might change after we have come up with a Solution (IT) as this is just tentative for now.

Complexity will be added in the future to the Predictive Models, in order to do complete complexity and risk-based triaging.

Quality Assurance is a random selection of XX% of cases for QA, assigned to QA group.

Workloads Distribution: Each bin can be assigned to officers according to operational requirements, expertise, levels, etc.

Triage Model Validation: A random selection of cases from bin #1 and # 2 will be assigned to officers at superior levels to ensure that:

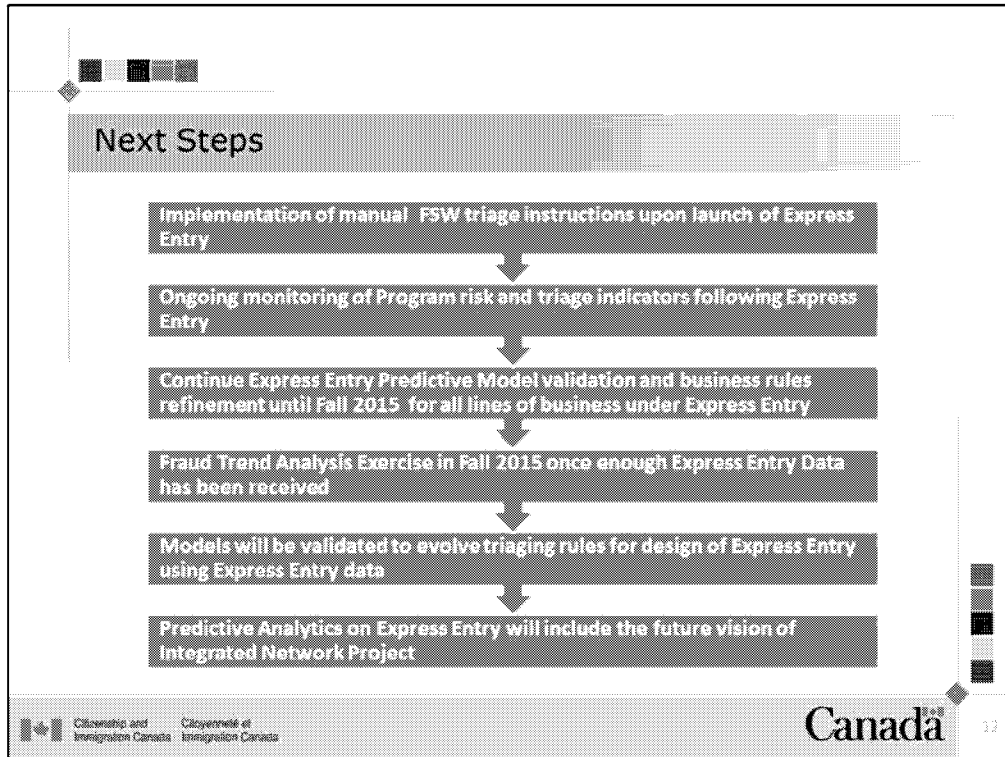Higher ranking officers remain exposed to all types of case.

Senior officers can continuously validate the Triage model.

Experienced officers can confirming that cases were effectively assigned to the right bin by the Triage model.

Experienced field officers can detect errors in the Triage model.

Experienced field officers can provide intelligence to centralised offices and HQ in order to improve and rafine the Triage model.

Note: For each application that comes into GCMS, the Predictive Analytics Models will produce the probability that predicted FinDec will be approved or refused. For FSW, PN, CEC was used C5.0. algorithm to develop the models. Each of these LOB has different output for probability bins.

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Marie-Josée/Ravi/David:

Details:

•It is anticipated to restart WG after receiving Express Entry data.
• need to validate model and allocation, but any feedback soon in the process will be appreciated.

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Additionally, some theoretical Indicators developed by PID include values that are not available in the source data. Therefore, the Program Risk Indicators developed for the FSW program were adapted to make use of the available data. A drawback to this approach is that the parts of the Risk Indicators that are not available in the data cannot be verified using statistical analysis and will have to be validated manually. To facilitate future automated triaging of cases based on the full set of Program Risk Indicators and predictive models, some characteristics of officer-work and of applications will need to consistently be captured within dedicated fields in GCMS rather than in notes, although these changes may take some time to develop and implement.

s.16(1)(b)

s.16(2)

Various combinations of the Indicators were tested against historical data to determine the overall approval rate and the volume of applicants that the parameters captured.

Use of this Indicator would result in the triage of an insignificant volume of FSW cases as non-complex and would not be useful for the purpose of capacity-based distribution

While this process was effective in refining some of the Program Risk Indicators, the complete list of Indicators is not finalized and will continue to be reviewed as new/evidence-based information or predictors are determined resulting from fraud trends analysis and further testing/validation.

DPAT has undertaken a detailed analytics exercise on FSW data to identify business rules and dependencies to model final decisions based partially on PID's Program Risk Indicators. Indicator fields within GCMS were agreed upon by the *Express Entry Data Analytics Sub-Woking Group.*[2]

3

Next Steps

OMC-PID will:

s.16(1)(b)
s.16(2)

- Support Permanent Resident Program Delivery (PRPD) in the drafting and further validating of file triage procedures for Express Entry to allow for the manual triage of files at launch
- Continue to support and validate DPAT Express Entry modeling work via ad hoc meetings and regular Express Entry Data Analytics Sub-Working Group meetings
- Continue working with DPAT in refining Program Risk Indicators and identifying new ones based on data and fraud trend analysis and further testing/validation of historical data
- Work with DPAT and PRPD on triage criteria / business rules for FSW and other Express Entry lines of business
- Support targeted program integrity and validation exercises on an ongoing basis following implementation of Express Entry PR triage criteria

OPMB-DPAT will:

-

- Triage/Business Rules for FSW
- Try testing the FSW model on new data
- Produce final FSW modeling document
- Continue data analysis and modeling for PNP Program.
- Begin examining data for CEC program.

4

Annex:

Revision of Program Eligibility Risk Indicators in FSW Programs

s.16(1)(b)

Background

s.16(2)

The FSW review/testing was administered to see if triage could be applied based on file complexity and capacity. This test would help indicate whether there is an optimal threshold to effectively triage applicant cases to where there is resource capacity to receive volumes.

Methodology

The methodology used focused on identifying non- complex cases as opposed to complex cases. Past experience with other business lines has also proven that non- complex indicators are more effective in defining and streamlining file distribution along the operational spectrum. By identifying non- complex cases all other cases that fall outside these criteria are considered complex.

The sample was compiled on random basis.

Data Information

The data used for review/testing included the following characteristics:

- Data was for the period of 2009 to 2014, as this was the most recent program information in GCMS
- Total Sample size used: 246,087 for all FSW final decisions (in GCMS)
- Total of 4 scenarios and sub-scenarios were tested.

- Please note data was randomly compiled

5

Pages 1250 to / à 1253

are withheld pursuant to sections

sont retenues en vertu des articles

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of the Access to Information Act

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Exempted from released under section 16 of the ATIA

Discussions with PID and DPAT

September 27, 2016

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Purpose of this presentation

- Present how we can best measure outcomes in this electronic world.
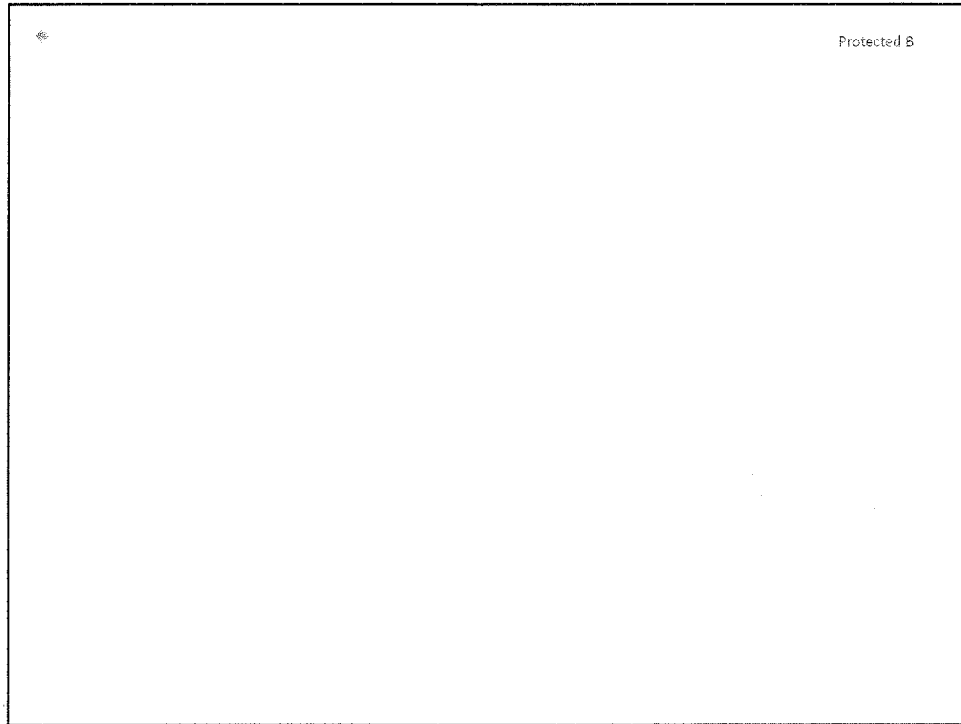
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- Problem

- Opportunity

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The Concept

27/09/2016

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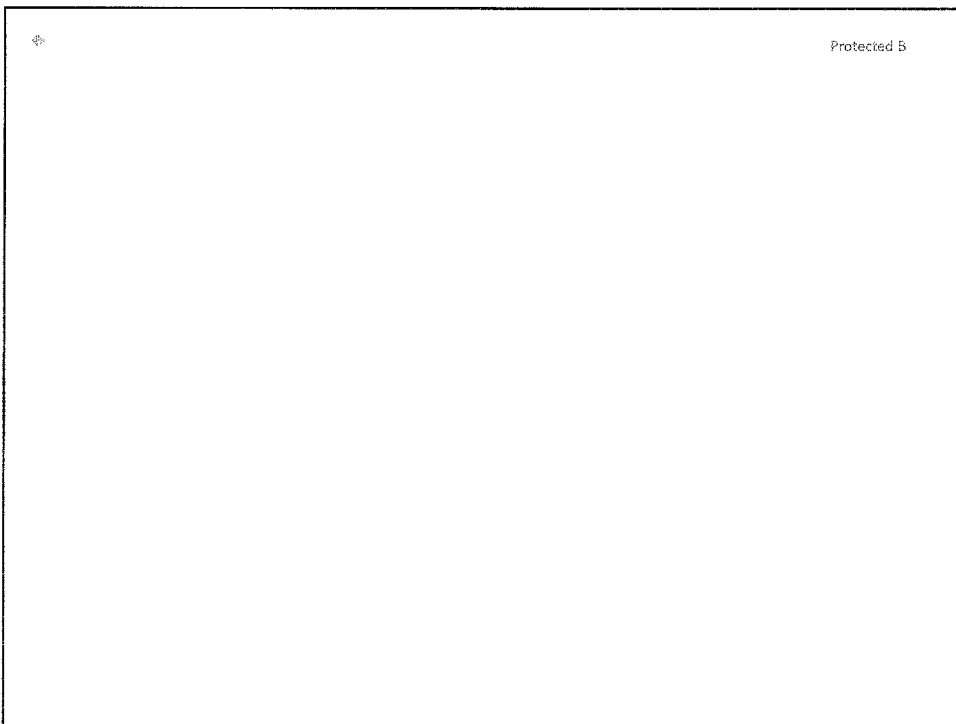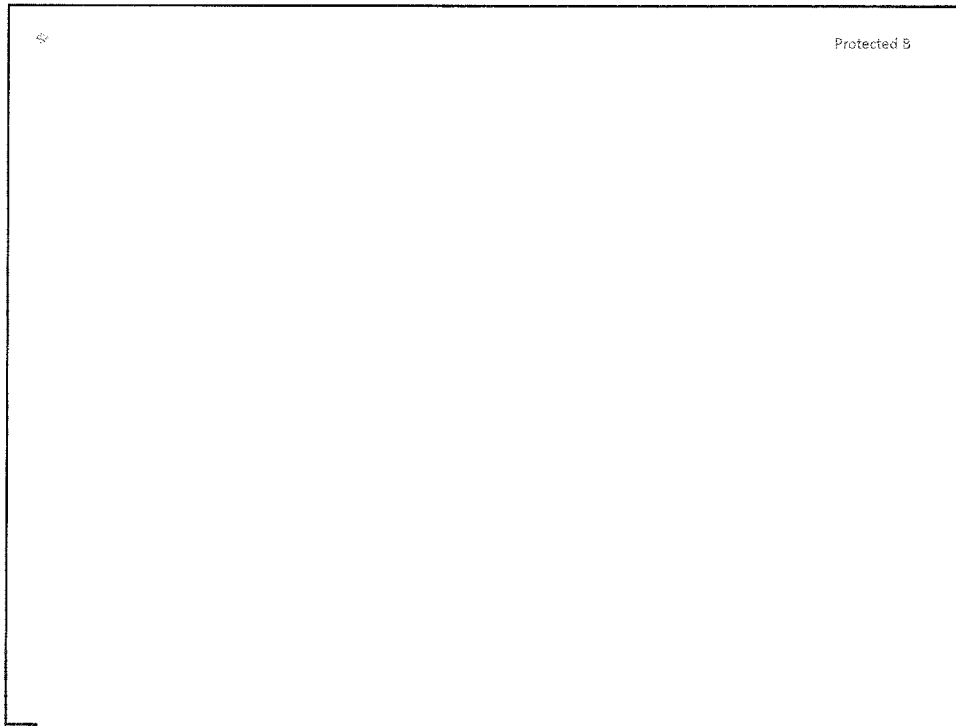
27/09/2016

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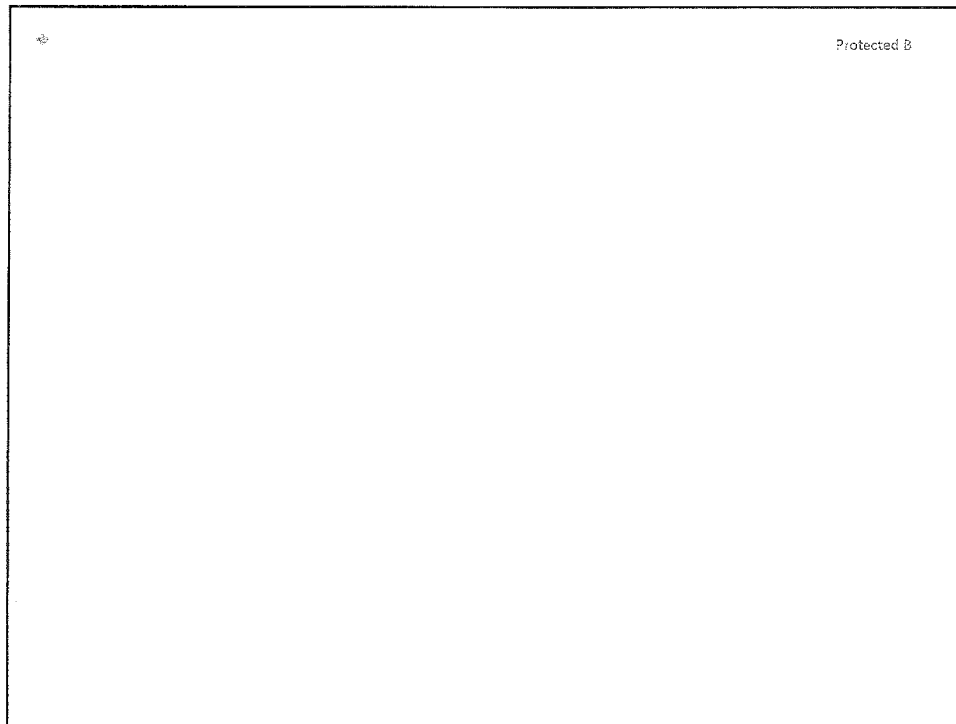- eTAs were originally meant to provide an advance screening mechanism for low-risk visa-exempt foreign nationals.

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Measuring Outcomes

- With GoC emphasis on Deliverology, measuring outcomes critical to demonstrating the success of an initiative.

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Measuring Outcomes (A Practical Vision)

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Governance

- A stable and nimble governance team will be key to positioning the project for success.
- It will be responsible for:

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Opportunities

- Provide an opportunity to fully measure outcomes.

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and Citizenship Canada   et Citoyenneté Canada

Associate Assistant   Sous-ministre
Deputy Minister   adjointe déléguée
Operations   Opérations

Ottawa K1A 1L1

F-962821
GCDOCS- 190290256

PROTECTED A

MEMORANDUM TO THE DEPUTY MINISTER

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TOOL TO SUPPORT LITIGATION MANAGEMENT –PILOT PROJECT

FOR APPROVAL

SUMMARY

- The purpose of this memorandum is to seek your approval to move forward with procurement activities to support a pilot, planned with the Department of Justice (DOJ), using an artificial intelligence/machine learning technology solution for immigration law. An artificial intelligence solution is sought to support legal research, analysing and predicting potential outcomes in litigation, and for trend analysis to support broader litigation strategy and program design. Artificial intelligence solutions would be used to support the work of officials of both the Department and the DOJ.

- A Request for Information is being prepared. The targeted timeline for posting is the end of March. We are seeking specific information from industry regarding what technology is available or could be developed. This is an initial exploration with industry and what we learn will inform whether we move forward with a Request for Proposal or another approach to procurement.

- We recommend that you approve this proposed initiative in order to move forward with this initial procurement step for an artificial intelligence/machine learning solution and related services for a litigation support pilot project by checking the 'I concur' box and signing this memorandum by March 20, 2018.

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BACKGROUND:

- Immigration, Refugees and Citizenship Canada (IRCC) and Employment and Social Development Canada (ESDC) are each partnering with the Department of Justice (DOJ) to explore the use of artificial intelligence and machine learning technologies and service options for separate pilots relevant to their work. IRCC's pilot will be in relation to immigration law and for ESDC's pilot will be in relation to the *Government Employees Compensation Act*. The Request for Information is seeking information for both pilots.

- The objective is to support the legal and litigation work performed by DOJ counsels, litigators and IRCC officials with a view to adding valuable information and insights to be leveraged in the performance of this work, finding efficiencies and saving time that can then be spent on other tasks

The Request for Information will explore the capability, viability and maturity of commercially available artificial intelligence and machine learning solutions that can:

- support case law and legal research;
- predict litigation outcomes and assist in the development of legal advice/legal risk assessments;
- facilitate trend analysis in litigation to inform litigation strategies, policy development and changes to operations;
- explore the potential for an "Artificial Intelligence assist-tool" for IRCC administrative front-end decision makers; and
- reduce litigation costs across various business lines.

- The Request for Information seeks to leverage industry expertise and obtain their perspective on the approach to these pilots including information in relation to the viable business models, contract considerations and hopefully resource and cost implications.

- By way of background, in 2017 the DOJ had a contract with an industry start-up, Blue J Legal, for a feasibility study to determine whether an artificial intelligence and machine learning tool could be developed to answer discreet immigration law questions using this technology and data available. Blue J Legal has developed artificial/machine learning tools designed to be used by professional practitioners in the fields of tax and employment law. These tools can be used to predict the outcome of litigation in respect of specific legal questions on a given set of facts. These tools provide a percentage likelihood of the court's ruling on the given question, together with a narrative analysis to support the conclusion that cites the key cases. The tool performs a real time analysis of the facts in light of every case decided on a given legal question.

- In June 2017, Blue J Legal presented their feasibility study to the Legal Issues Management Committee of IRCC.

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The Request for Information will allow industry vendors to provide further information on the scope of artificial intelligence and machine learning solutions that are available and will help inform the Department on whether to move forward with a tool limited to legal services/litigation support or one that will support administrative decision-making and/or possibly other functionality.

CURRENT STATUS:

- IRCC and the DOJ are working together to explore the development of artificial intelligence and machine learning solutions for immigration law with a view to launching a pilot of such a tool.

- A Request for Information is being drafted as a first step towards the development of an artificial intelligence and machine learning solution for immigration law.

s.21(1)(a)

s.21(1)(b)

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ESDC has joined the IRCC/DOJ draft Request for Information because they are also interested in developing artificial intelligence and machine learning tools for law.

*

Deadlines are to be confirmed but the plan is to post the Request for Information towards the end of March 2018.

CONSULTATIONS:

*

For instance, IRCC has completed a pre-pilot in November 2017, testing automated decision-making of positive decisions, driven by predictive analytics, for the immigration offices in the China processing network's Temporary Resident Visa line of business. The next phase will be a pilot in China in March 2018 with expansion to Temporary Resident Visa applications from India, later in 2018.

* Consultations with Public Services and Procurement Canada are continuing.

* A departmental working group has been established that includes Case Management Branch, Departmental Legal Services, Solutions and Information Management Branch and the Procurement group from the Administration, Security and Accommodation Branch.

RESOURCE IMPLICATIONS:

* It is difficult to estimate the financial costs of this initiative as they are unclear at this time. Preliminary estimates point to a range of roughly   solely for the development of a solution by industry to pilot a tool where a classifier is available for one IRCC business line (e.g. Pre-Removal Risk Assessments or Humanitarian and Compassionate applications). This preliminary rough estimate does not cover all internal costs such as planning, managing the project, implementation, training and maintenance. Discussions with Public Services and Procurement Canada are continuing regarding procurement activity costs. The purchase price, and the development and implementation costs are not known at this time and depend upon the solution.

* Immediate costs for the procurement process are manageable. It is anticipated that the results of the Request for Information will allow the Department to estimate the costs for the pilot project with more precision. As the project progresses IRCC will be better positioned to proceed with detailed cost analyses to ascertain the investment needed to cover the total costs of all of the phases of the artificial intelligence and machine learning litigation project.

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- In terms of human resources, a combined total of one FTE in the Case Management Branch is working on the initial set-up phase (planning and initial procurement activities) relying on ongoing support and collaboration of departmental staff members who have been involved in this proposed initiative to date. The funding for this work is currently being absorbed at the branch level. As the project evolves, more resources will be needed. Case Management Branch will work in close collaboration with the Financial Management Division to monitor and ascertain specific needs.

- IRCC is in the process of entering into a Memorandum of Understanding with Public Services and Procurement Canada to assign dedicated resources and expedite timelines for the project. Based on the financial implications of some other artificial intelligence initiatives being developed in the Department, costs to cover dedicated resources and procurement activities for Public Services and Procurement Canada could total around $125,000.

- Financial Management Directorate has advised that, in the initial set-up phases (i.e., costs for the Public Services and Procurement Canada Memorandum of Understanding, first-year FTEs, etc.), a strategy of attempting to manage costs through surpluses within Case Management Branch (and by extension, the Operations Sector) could be employed as a first step. Failing that, the Department would be able to secure another source of funds as the need arises. As the extent of ongoing costs becomes clearer, a longer-term financial strategy would be developed.

COMMUNICATION IMPLICATION(S):

- As this memo concerns procurement activities intended for internal use, communications implications are expected to be fairly minimal. Responsive key messages will be prepared as needed.

RECOMMENDATION:

- We recommend that you approve this proposed initiative in order to move forward with the Request for Information and related procurement activities for an artificial intelligence and machine learning solution and related services for litigation support by checking the 'I concur' box and signing this memorandum by March 20, 2018.

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NEXT STEPS:

- Continue the preparation of a procurement plan with Public Services and Procurement Canada.

- Launch of the Request for Information to private industry. With information received in response to the Request for Information, the procurement plan would be updated and it is expected that a Request for Proposal or another procurement approach would follow.

- Creation of a preliminary work plan and work flow process for the project with consideration as to which IRCC activities would be in scope for the pilot.

- Monitoring project workload to ascertain if additional dedicated resources for this initiative in Case Management Branch and other areas are needed.

Dawn Edlund

☑ I concur

☐ I do not concur

Marta Morgan

Public Works and
Government Services
Canada

Travaux publics et
Services gouvernementaux
Canada

RETURN BIDS TO:
RETOURNER LES SOUMISSIONS À:

Systems Software Procurement Division / Division
des achats des logiciels d'exploitation
Terrasses de la Chaudière
4th Floor, 10 Wellington Street
4th etage, 10, rue Wellington
Gatineau
Quebec
K1A 0S5

LETTER OF INTEREST
LETTRE D'INTÉRÊT

Comments - Commentaires

Vendor/Firm Name and Address
Raison sociale et adresse du
fournisseur/de l'entrepreneur

Issuing Office - Bureau de distribution

Systems Software Procurement Division / Division des
achats des logiciels d'exploitation
Terrasses de la Chaudière
4th Floor, 10 Wellington Street
4th etage, 10, rue Wellington
Gatineau
Quebec
K1A 0S5

Title - Sujet	
Artificial Intelligence Solution	

Solicitation No. - N° de l'invitation	Date
B8607-180311/A	2018-04-19

Client Reference No. - N° de référence du client	GETS Ref. No. - N° de réf. de SEAG
B8607-180311	PW-$$EE-017-33462

File No. - N° de dossier	CCC No./N° CCC - FMS No./N° VME
017ee.B8607-180311	

Solicitation Closes - L'invitation prend fin
at - à   02:00 PM
on - le 2018-05-10

Time Zone
Fuseau horaire
Eastern Daylight Saving
Time EDT

F.O.B. - F.A.B.

Plant-Usine: Destination: Other-Autre:

Address Enquiries to: - Adresser toutes questions à:	Buyer Id - Id de l'acheteur
Ferrier, Heather	017ee

Telephone No. - N° de téléphone	FAX No. - N° de FAX
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Vendor/Firm Name and Address
Raison sociale et adresse du fournisseur/de l'entrepreneur

Telephone No. - N°de téléphone
Facsimile No. - N° de télécopieur

Name and title of person authorized to sign on behalf of Vendor/Firm
(type or print)
Nom et titre de la personne autorisée à signer au nom du fournisseur/
de l'entrepreneur (taper ou écrire en caractères d'imprimerie)

Signature   **Date**

Canadä

A-2018-09320-001268

Version last amended - 19/04/2018 9:11 AM

Artificial Intelligence Solution

Immigration, Refugees and Citizenship Canada
Employment and Social Development Canada
Department of Justice

Request for Information
April 2018

Table of Contents

Version last amended - 19/04/2018 9:11 AM

1   Background and Purpose of this Request for Information

Objectives of the RFI

Through this Request for Information (RFI), Immigration, Refugees and Citizenship Canada (IRCC), Employment and Social Development Canada (ESDC) and the Department of Justice (DOJ) are seeking to understand how each respective department could leverage the benefits of

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artificial intelligence (AI)[1], machine learning (ML) and predictive analytics (PA) technologies to support decisions involving legal considerations, support the development of litigation strategies, and generate new insights and efficiencies in the delivery of legal services and litigation support to the Government of Canada.

There are two separate pilot projects being explored. IRCC and the DOJ are partnering to develop an AI/ML powered solution for immigration law. ESDC and the DOJ are partnering to develop an AI/ML powered solution to support work under the *Government Employees Compensation Act* (*GECA*). Specifically, AI/ML powered solutions leveraging data-driven insights are sought to assist and inform three activities:

- legal research and development of legal advice/legal risk assessments;
- prediction of outcomes in litigation; and
- trend analysis in litigation.

Information is also sought in relation to whether use of any AI/ML powered solutions could be expanded, in future, to users such as front-end decision makers.

While IRCC and ESDC are pursuing separate projects, the two departments share the objectives of using this RFI to receive feedback, ideas and suggestions from industry respecting AI/ML technologies and solutions that will meet their needs. Information provided by industry will inform procurement(s) to support these pilot projects, should a procurement be pursued.

Information provided in response to this RFI need not respond to both pilot projects and may be limited to responses in relation to an AI/ML powered solution for either immigration law or the *GECA*.

The list of questions in section 5 are meant to allow industry to:
   a) share views and inform the direction that IRCC, ESDC and the DOJ may take with respect to AI/ML;
   b) comment on the risks associated with AI/ML powered solutions and mitigation strategies for reducing those risks;
   c) inform the parameters that IRCC, ESDC and the DOJ may consider in determining scope and when or if an AI application is appropriate for achieving desired business objectives; and
   d) provide ideas and suggestions as to how IRCC, ESDC and the DOJ could position their respective security and privacy frameworks in light of AI.

The information provided will aid in increasing the understanding of the capability, viability and commercial availability of AI/ML technology solutions and services. The industry perspective on the approach, business and general requirements, cost of development, viable business models and related contract and intellectual property considerations are of particular interest.

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[1] Recognizing that there is not a consistent agreement as to what constitutes artificial intelligence, including whether or not certain types of machine learning fall within the AI spectrum, for the purposes of this RFI respondents are asked to provide their responses considering a broad and inclusive approach to AI, including machine learning technologies.

Background

The Government of Canada has been exploring data analytics for a number of years in an effort to understand developments in the field and its implications for federal departments and the legal industry.

IRCC, ESDC with the DOJ are pursuing two separate pilot projects that will use AI/ML powered solutions leveraging data-driven insights to aid in:

- research and development of legal advice/legal risk assessments;
- prediction of outcomes in litigation; and
- facilitating trend analysis in litigation.

It is expected that the primary users of these two solutions would include the respective IRCC and ESDC departmental officials and DOJ counsel involved in litigation support.

Information is also sought to inform potential expansion of AI/ML powered solutions to other uses/users in these domains such as front-end administrative decision makers. Such a solution could be used to assist and provide additional information for front-end decision making.

While the business needs for each department, articulated in section 2, are focused on different sets of program activities, one set for immigration law and one set for *GECA*, the information obtained from this RFI will help inform each department's broader AI/ML plans and further initiatives.

2   Business Requirements

This RFI seeks information in relation to two separate solutions, one for IRCC/DOJ and one for ESDC/DOJ. Each AI/ML solution is sought to help enhance: analytical capacity; speed, accuracy and effectiveness of legal research; speed, comprehensiveness and accuracy of answers to legal questions; prediction of litigation outcomes; and trend analysis in litigation. The additional objective is to streamline and find efficiencies in a number of different legal and business activities taking place within IRCC, ESDC and the DOJ.

2.1 IRCC Decisions, Litigation and Trends

IRCC is seeking a solution to assist in legal research, assist in the development of legal advice/legal risk assessments using predicted outcomes in litigation and to provide litigation trend analysis. There are many different areas of immigration law where IRCC officials make administrative decisions that are litigated. DOJ counsel and paralegals, together with IRCC Litigation Analysts, review, respond to and manage the volume of litigation.

Administrative decisions made at IRCC are subject to judicial review before the Federal Court. The DOJ has litigation counsel, DOJ Departmental Legal Services Unit (IRCC DLSU) litigation support counsel acting as in-house counsel to IRCC and paralegals who are variously involved from the point at which an application for leave for judicial review of an IRCC decision is filed through to its conclusion. Depending upon the complexity of the file, DOJ counsel, located either in regional offices across Canada or in Ottawa, may spend several hours per file researching, analyzing and

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advising as part of the management of the litigation. Litigation Analysts at IRCC also spend several hours per file reviewing, analyzing, and liaising with program and policy areas and coordinating a departmental approach as the instructing client. This combined DOJ-IRCC effort includes time spent working together to determine the position(s) to be taken in the litigation, along with assessing implications and risk in relation to the litigation. Concerning the current environmental context, the DOJ and IRCC conducts the legal research and legal analysis functions manually. On a preliminary basis, IRCC has areas of immigration law where it seeks to pilot AI/ML solutions: Pre-Removal Risk Assessment applications and Humanitarian & Compassionate consideration applications (both made from within Canada). The high-level functionality sought is as follows:

- Allow users to conduct detailed research of case law relevant to a particular legal question and factor(s);
- Use historical data to predict the likelihood of a case being successfully litigated;
- Provide an analysis or narrative explaining which factors about a specific case are most relevant for predicting the likelihood of successful litigation; and
- Identify/summarize the relevance of similar cases within the existing case law history.

Optional functionality sought is as follows:

- Allow users to conduct exploratory data analysis of trends in immigration case law and the factors influencing these trends; and
- A solution that could also be used by front-end administrative decision makers to predict litigation outcomes as a consideration in their decision-making process.

A solution is sought to assist in the analysis of trends in immigration litigation/case law - a broad-based solution that can analyze large volumes of immigration litigation data (i.e., case law) to assist in the development of policy positions, program decisions and program guidance relevant to decision making and litigation would be ideal. For example, the capacity to analyze trends in case law, such as key facts that are influencing outcomes in litigation, would be valuable to IRCC and the DOJ.

Users of the solution(s)

The users of a possible AI solution would be IRCC Litigation Analysts, DOJ Departmental Legal Services Unit counsel and regional DOJ litigators and paralegals who are involved in litigation management. With the responses to this RFI, IRCC will explore the possibility of whether or not the AI/ML powered solution(s) could also be used by front-end IRCC administrative decision-makers across the domestic and international networks to aid in their assessment of the merits of an application before decisions are finalized. This could entail separate client interfaces or functionality depending upon the user group.

Available Data

The data to be used by the AI/ML solution(s) would include published court decisions and general case factors, and, in future, possibly departmental applicant records (both structured and unstructured) contained in its system/database of record.

2.2 ESDC Decisions, Litigation and Trends:

ESDC delivers a range of programs and services that affect Canadians throughout their lives such as providing Canada Pension Plan and Old Age Security pensions and related benefits, supporting unemployed workers, helping students finance their post-secondary education, and assisting parents raising young children. The Labour Program fosters safe, healthy, fair and inclusive work environments and cooperative workplace relations in the federal jurisdiction.

ESDC is in the midst of a Service Transformation Plan which includes a number of service solutions that will leverage artificial intelligence and machine learning to deliver client-specific service insights and support. Likewise, ESDC's Benefits Delivery Modernization initiative seeks to improve e-service and automation to streamline the processing of Canada Pension Plan, Old Age Security, and Employment Insurance claims, facilitate interactions with Canadians, and enable self-service for low complexity requests.

ESDC's Legal Services Unit provides legal services to support the programs, operations and key initiatives, including legislative and regulatory initiatives of ESDC, Labour Program, Service Canada, and Veterans Affairs Canada. The Legal Services Unit also provides litigation and litigation support services, which includes:
- appearing before the Social Security Tribunal and Federal Courts of Canada on appeals and judicial reviews respecting the Canada Pension Plan, the *Old Age Security Act* and the *Employment Insurance Act*;
- seeking settlement recoveries related to the *Government Employee Compensation Act* program, managed by the Labour Program.

It is within this context that ESDC is pursuing information on AI/ML solutions which support early legal risk assessment, informs litigation strategy, and the identification of potential efficiencies in the delivery of legal services.

The high-level functionality sought is as follows:
- Allowing users to conduct detailed research of case law relevant to a particular legal question and factor(s);
- Determining the probability that a given fact scenario meets the threshold for benefit eligibility, or is a viable claim (e.g. likely to result in a settlement);
- Identifying what information may be missing in order to meet this threshold;
- Identifying the dollar range of the settlement that could successfully be negotiated; and
- Identifying/summarizing the relevance of similar cases within the existing case law history.

Should there be suitable tools available, ESDC would likely explore opportunities to pilot a solution for a select program area, in order to assess the potential for scaling the solution in other contexts.

ESDC Potential Use Case: Government Employee Compensation Act (*GECA*) program

When an employee of the public service of Canada suffers an injury resulting from an accident or an occupational disease in the course of their employment, they are eligible for the benefits provided by the *Government Employees Compensation Act* (*GECA*) (http://laws-lois.justice.gc.ca/eng/acts/G-5/).

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Where a third party is liable for the injury, the Labour Program seeks to recover the Crown's costs from that third party. Once assigned a case by the Labour Program, the Legal Services Unit leads the early assessment of claim viability, and leads the negotiation of settlements with the third party. Viable claims for which ESDC has not been able to negotiate a settlement, and higher value claims that have insufficient information to assess before the Statute of Limitation date, are sent to the DOJ for litigation. DOJ counsel, located either in regional offices across Canada or in Ottawa, then assume carriage of the file, and may spend several hours per file researching, analyzing and advising as part of the management of the litigation.

Available Data

The data (structured and unstructured) to be used by the AI/ML solution and model includes published court decisions, an administrative *GECA* database, and additional administrative records.

Users of the solution(s)

Dispute resolution advisors, paralegals, and counsel within the ESDC Legal Services Unit would use this solution as a research aid in developing their strategy in settlement negotiations, as well as a resource in the determination of which claims to send to DOJ counsel for litigation.

3   Instructions to Respondents

Nature of request for information

This is not a bid solicitation. This RFI will not result in the award of any contract. As a result, potential respondents of any goods or services described in this RFI should not reserve stock or facilities, nor allocate resources as a result of any information contained in this RFI, nor will this RFI result in the creation of any source list. Therefore, whether or not any potential respondent responds to this RFI will not preclude that respondent from participating in any future procurement. Also, the procurement of any of the goods or services described in this RFI will not necessarily follow this RFI. This RFI is simply intended to solicit feedback from industry with respect to the matters described in this RFI. IRCC, ESDC and the DOJ are interested in technology and solutions that would enhance the efficiency and effectiveness of the litigation management and front-end decision-making processes.

Format of Responses Requested

a) **Format**: Respondents are requested to submit one soft copy of their response in Portable Document Format (PDF).

b) **Cover Page**: If the response includes multiple volumes, respondents are requested to indicate on the cover page of each volume the title of the response, the solicitation number, the volume number and the full legal name of the respondent.

c) **Title Page**: The first page of each volume of the response, after the cover page, should be the title page, which should contain the:
   a. title of the respondent's response and the volume number;
   b. name and address of the respondent;
   c. name, address and telephone number of the respondent's contact;

    d. date; and

    e. RFI number.

d) **Part A should include the Proposed Solution with references to the Business Requirements as depicted in Section 2 and the General Requirements in Section 4.**

e) **Part B should include answers and feedback to the questions listed in Section 5. Please identify which department/pilot project the responses relate to.**

f) **Numbering System:** Each question has its own unique number. It is a sequential number prefixed with a "Q". Respondents are requested to prepare their response using the numbering system corresponding to the one in this RFI, and to repeat the question prior to their response for ease of reviewer reference. All references to descriptive material, technical manuals and any brochures included as part of the response should be clear both in the citation and on the referenced document. All should be referenced accordingly.

Response Costs

The Government of Canada will not reimburse any respondent for expenses incurred in responding to this RFI.

Treatment of Responses

a) **Use of Responses:** Responses will not be formally evaluated. However, the responses received may be used by the Government of Canada to develop or modify procurement strategies or any draft documents contained in this RFI. The Government of Canada will review all responses received by the RFI closing date. The Government of Canada may, in its discretion, review responses received after the RFI closing date.

b) **Review Team:** A review team composed of representatives of IRCC, ESDC and the DOJ will review the responses. The Government of Canada reserves the right to hire any independent consultant, or use any government resources that it considers necessary to review any response. Not all members of the review team will necessarily review all responses.

c) **Confidentiality:** Respondents should mark any portions of their response that they consider proprietary or confidential. The Government of Canada will handle the responses in accordance with the Access to Information Act.

d) **Pre-Submission Industry Day Sessions:** The Government of Canada may, in its discretion, host one or two industry day sessions for the purpose of explaining its requirements and to allow industry to ask questions and seek clarifications.

e) **Post-Submission Review Meetings:** The Government of Canada may, in its discretion, hold a single Post-Submission Review Meeting with all interested vendors or request individual Post-Submission Review Meetings with selected respondents to provide clarity on information provided, or to invite a presentation about some or all of the proposed solution. If required, these will be held at the most appropriate location, to be determined at a later date. The intent of these meetings will be to provide an opportunity for a face-to-face discussion with respondents. Although respondents may request a meeting, and their request will be considered, the Government of Canada will determine whether or not it requires additional information from

Immigration, Refugees   Immigration, Réfugiés
and Citizenship Canada   et Citoyenneté Canada
Information disclosed under the Access to Information Act
L'information divulguée en vertu de la loi sur l'accès à l'information

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any given respondent and will schedule meetings accordingly. All such requests, by respondents, should be forwarded to the Contracting Authority identified herein. Note that a maximum of two (2) hours will be set aside for any meetings with respondents.

Enquiries

Because this is not a bid solicitation, the Government of Canada will not necessarily respond to enquiries in writing or by circulating answers to all potential respondents. However, respondents with questions regarding this RFI may direct their enquiries to the Contracting Authority identified herein.

Submission of Responses

a) Respondents should send responses electronically via e-mail to the Contracting Authority's e-mail address identified herein by the date specified on the front page of the RFI.

b) All requested information is to be provided to the Contracting Authority on or before the closing date of the RFI.

Contracting Authority

The Contracting Authority for this RFI is:

    Contracting Authority: Heather Ferrier
    E-mail Address: heather.ferrier@tpsgc-pwgsc.gc.ca
    Telephone: 613-720-7986

4   General Requirements

Availability requirements

The solutions may be made available to officials of IRCC, ESDC and the DOJ nationally (across Canada). The number of users will vary between activities. The user base may be extended to IRCC officials stationed overseas in possible future deployments of the solution(s).

Language

The *Official Languages Act*, R.S.C., 1985, c. 31 (4th Supp.) requires that regularly and widely used work instruments be made available in both English and French to government officers and employees. Consequently, the solution will require a bilingual user interface. Training documentation and user manuals will also need to be made available in both English and French. A desirable feature would be for the users to be able to toggle on-the-fly between English and French within the solution.

Support

The respondent should indicate their organization's approach to the management of incidents and problems and illustrate how issues are escalated and resolved.

Maintenance

The respondent must be prepared to illustrate their problem/change management procedures for ongoing updates to the solution(s), their maintenance procedures for the solution(s) and explain their approach concerning emergency fixes and problem escalation procedures and resolutions. The frequency of solution updates/releases and the downtime, if any, associated with updates/releases to the solution would be helpful to know.

Training

The respondent must provide a training strategy and approach to the creation and dissemination of user education material.

Security

The solution(s) must secure solicitor-client privileged information and data and must achieve a minimum of a Protected B level of security. Protected B is the federal level of security that applies to information and assets that, if compromised, could cause serious injury to an individual, organization or government.

The respondent must be aware that, at this time, IRCC, ESDC and the DOJ assume that the security profile for Protected B information will be mid-integrity and mid-availability as per the Government of Canada's ITSG-33 policy and procedures (as contained at the following link: https://www.cse-cst.gc.ca/en/publication/itsg-33).

It should be noted that for user access controls, the solution(s) need(s) to accommodate users from multiple departments (IRCC/DOJ and ESDC/DOJ for the respective solutions.

It is desirable to implement Single Sign-on (SSO) using services such as Active Directory and other Public Key Infrastructure solutions to allow for remote access to Government of Canada networks.

Access rights can or will be set for the DOJ, IRCC and ESDC or third parties as required.

Reporting capability

The respondent must describe the reporting capabilities of the solution(s) and any reports and data visualization provided with the solution(s) (e.g., ad hoc reporting, canned reports, visualization and drill down capabilities for analyzing algorithm decisions, etc.).

5   List of Questions

Company Overview

1. Please provide a short description of your firm, its facilities and locations and the types of products and services it provides.
    i.   In which country/countries are your facilities located?
    ii.   In which country/countries does your firm conduct business?
    iii. How long has your firm been in business?
    iv.   Has your firm previously received security clearance to work with the Government of Canada?

2. Have you provided AI/ML solutions or developed prototypes for public sector or private sector organizations in Canada or elsewhere? If so, what were the objectives and the high-level functionality of the solution(s), and what are some lessons learned from the experience(s)?

The Solution

3. Please provide detailed information about a potential solution, including a description of:
  i. How the general business requirements could be addressed by the solution;
  ii. Significant gaps in the identified requirements or how they could be improved;
  iii. The nature of the analysis and the supporting information the solution will provide to users for the three activities identified being research, prediction and trend analysis;
  iv. Whether or not the legal questions to be answered by the solution need to be discrete and fact-based;
  v. Conceptually, how the solution would take the facts of an individual case and arrive at a predicted outcome of the litigation;
  vi. How the solution would be adapted to address changes in the law (case law or legislation);
  vii. How the algorithm or neural network is trained;
  viii. The volume or nature of training data (e.g., applications/claims/facta/judicial decisions) that would be required to allow for accurate predictions of legal outcomes and why that volume is needed.

Viewpoint on AI/ML Technology, Maturity & Limitations

4. What challenges do you foresee in developing and implementing AI/ML solutions and what solutions exist to overcome those challenges? What are the unique considerations in the government setting?
  i. How would industry address the challenge of demands to make AI/ML models transparent to ensure that the predicted outcomes can be reviewed and the rationale understood (e.g., which factors were the most important in influencing the predicted outcome, and how was the predicted outcome developed)? What would be the consequences in this context of releasing such information?
  ii. What are the pitfalls, weaknesses and critical dependencies in AI solutions for the identified requirements?
  iii. How can AI/ML models be developed to ensure biases or potential biases are not introduced? How are biases detected?

5. How would you characterize and define the different types of AI/ML technologies?

6. What solutions do you consider to be mature, developing or in the early stages of implementation that are appropriate for the identified requirements? Are solutions available to meet the identified requirements or could solutions be customised or configured to meet these requirements? Should solutions not be available to meet identified requirements could a solution(s) be developed with available AI/ML technology? Please explain.

7. Whether a Commercially Off The Shelf (COTS) products exists or a solution needs to be developed to meet identified requirements:

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    i.   What level of client capacity and involvement is required to develop a solution or to support the use of COTS (including customization and configuration) for AI/ML solutions?

   ii.   Would any solution developed or COTS products allow for AI/ML models to be developed, re-trained or adjusted as required for more than one area of the law or to answer more than one legal question? That is, how reusable/transferable is the technology such that a solution could be adapted for use for multiple areas of the law or to answer multiple legal questions?

  iii.   Is it possible that a solution could accommodate requirements and users from different departments (IRCC/DOJ and ESDC/DOJ for the respective pilot projects) or are separate solutions required to accommodate their respective requirements and users?

  iv.   Are there design considerations in an AI/ML solution that would allow it to have the widest range of potential applications/uses beyond the identified requirements? If yes what are the major design considerations? What are the key elements to consider in terms of such reusability and transferability?

Approach to Developing and Implementing AI/ML Solutions

8. What are the major considerations and critical components that need to be taken into account with respect to developing and operationalizing AI/ML solutions? For example:

    i.   Are there complementary software or hardware dependencies that need to be in place for an AI/ML model to function correctly?

   ii.   What interoperability capacity would your solutions have with other commonly used products (such as Microsoft SharePoint, OpenText document management, Customer Relationship Management (CRM), case management solutions, Statistical Package for the Social Sciences (SPSS), SAS, Oracle, etc.)?

  iii.   Are there any special CPU, memory, storage, network or database requirements?

  iv.   How is OS, server patching and third party middleware upgrades handled? (i.e., schedule, frequency, on demand)?

9. What are the industry's standards, best practices or measures that can be used to assess the efficiency, accuracy, reliability and performance of such AI/ML solutions?

    i.   Explain how efficiency, accuracy and reliability of such solutions would be ensured and measured? Please explain including in relation to the solution's analytical and predictive capabilities?

   ii.   Can you measure accuracy of predictions of outcomes/trends such as by a margin of error? If yes, what is the margin of error?

  iii.   Can you measure accuracy of the solution's other outputs (information/analysis) such as by margin of error? If yes, what is the margin of error?

  iv.   What is the performance of such solutions (e.g., response time for a research/prediction of outcome/trend analysis including the supporting information provided by the solution)?

10. Please advise of any other industry standards or best practices that should be followed for the development or deployment of AI/ML solutions that were not already addressed in your previous responses.

11. With an AI/ML solution development and deployment, what is the role of clients? For example:
    i.   Can client users train and re-train the AI/ML models, or would this require additional customization, support or permissions?
    ii.   Can clients configure data, rules, algorithms and fine-tune decisions? If yes how?
    iii.   Can data/rule configuration be done by the client in production or does it need back-end technical support/release management?
    iv.   Are any specific programming and scripting skills/training required or additional professional services required?
    v.   How can users review the algorithm decisions?

Training & Support

12. Please provide an overview of the training and support services available, including considerations for implementing the solution across Canada, potentially across different governement departments and possibly overseas in future iterations.

Additional Technical Considerations

13. Please explain:
    i.   the languages and/or character sets supported for the import, export and manual entry of data into the solution;
    ii.   any dependencies on third party software components necessary to deploy the solution;
    iii.   details related to the support of any third party components (e.g., source of support, method of delivery, maintenance, etc.);
    iv.   integration points between requirements, where applicable, and any value-added software products/solutions;
    v.   the level of Government of Canada IT resources required to support the solution (e.g., hardware, software, etc.);
    vi.   How many minor and major releases are planned in a year? Are there solution outages associated with the different types of releases? If there are solution outages, what is the average time of the outage based on release type?
14. What are the various hosting options available for the proposed solution(s) that allow for data to reside and remain within Canada (e.g., Software as a Service (SAAS), Infrastructure as a Service (IAAS), Platform as a Service (PAAS), on-premise instances, etc.)?

    i.   For each option, please describe the security architecture and how it meets the Government of Canada security standards and protocols (http://www.tbs-sct.gc.ca/pol/topic-sujet-eng.aspx?ta=27).
            The Treasury Board Secretariat (TBS) Cloud Adoption Strategy is also included for reference: https://www.canada.ca/en/treasury-board-

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secretariat/services/information-technology/cloud-computing/government-canada-cloud-adoption-strategy.html.

    ii.   If cloud-based, how is tenancy security implemented?

    iii.   Describe the business continuity plan to address unforeseen circumstances.

    iv.   Please identify any other hosting considerations that should be taken into account by the Government of Canada. It should be noted that any off-premises hosting solution must meet the data sovereignty requirements for data to be hosted in Canada.

15. What would be the expected length of time required to provide a solution that meets the aforementioned requirements?

User Accessibility & Usability

16. How does the potential solution address the following:

    i.   What mechanisms are in place to meet Web Content Accessibility Guidelines (WCAG)?

    ii.   How are input data sets entered into the system (e.g., manual data entry, spreadsheet imports, graphical)?

    iii.   How are decisions reviewed (e.g., lists, graphical, reports)?

Data

17. What data sources would you recommend for use to develop such a solution to meet the identified requirements i.e. for the three activities identified being research, prediction and trend analysis?

18. How can industry leverage and integrate public information repositories in AI/ML models? How can information repositories internal to government departments be integrated?

    i.   How would you solve the challenge of working with and analyzing large volumes of unstructured data?

19. Should IRCC or DOJ databases be required, what is involved in leveraging or integrating an AI solution with existing databases and what data requirements/inputs would need to be developed for an AI solution, whether it includes internal data and/or publicly-available data?

20. Are industry data standards used for the specification of inputs and decisions?

21. Are industry-standard AI/ML algorithms used (e.g., Bayesian, Decision Trees, Neural Networks, Linear Regression)?

Privacy & Protection of Information

22. How does industry ensure that privacy and confidentiality are protected when applying AI/ML technologies to personal information holdings?

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    i.   What best practices can be used to address privacy concerns and the requirements in the *Privacy Act* (http://laws-lois.justice.gc.ca/eng/acts/p-21/), *Personal Information Protection and Electronic Documents Act* (http://laws-lois.justice.gc.ca/eng/acts/P-8.6/), and Part IV of the *Department of Employment and Social Development Act* (http://laws-lois.justice.gc.ca/eng/acts/H-5.7/FullText.html)?

23. When analyzing sensitive data in an AI/ML model, how is confidentiality ensured for information that must be protected (e.g., solicitor-client privileged information)?

24. How does the potential solution address IT security?

    i.   Application: What mechanisms/processes are in place
        a) To prevent unauthorized access or data integrity compromise?
        b) For logging and auditing user events, rule / algorithm changes and AI algorithm decisions?
        c) To handle access control and at what level of granularity (e.g., field level, case level, decision level)?

    ii.   Information Management: What mechanisms/processes are in place:
        a) To protect the input data?
        b) For data retention and disposition?
        c) To package and transfer data back to the Government of Canada if the solution is discontinued?
        d) For reporting security incidents and violations?
        e) For disaster recovery and business continuity?

Intellectual Property (IP)

25. Please describe the options for the intellectual property rights, taking into account the viable business models for the solutions, such as vendor-owned and Government of Canada-owned.

Cost Model

26. Please describe the options for the pricing model for a vendor-owned solution (e.g., perpetual licence, subscription-based licence, user licence, device/CPU/server licence, entity/enterprise licence, other model)? What is the estimated cost to develop and maintain such products and services?

27. Where a Government of Canada-owned solution is developed because a vendor-owned solution is not viable, what would be the estimated cost for the products and services? What is the estimated cost to develop and maintain such a solution?

To/À :	**Deputy Minister/Sous-ministre**	Date:	January 17, 2018

From/De :	**Associate Assistant Deputy Minister, operations / Sous-ministre adjointe déléguée, opérations**
Subject/Objet :	For Approval: Artificial Intelligence/ Machine Learning Tool to Support Litigation Management
Attachment/ Pièce jointe :	Annex: 1 Case Management Branch's November 2017 Presentation to Legal Issues Management Committee 2 Artificial Intelligence/Machine Learning Tool Case Law

DISTRIBUTION DIFFUSION	SUPPLEMENTARY DISTRIBUTION DIFFUSION SUPPLÉMENTAIRE	FILE CODES/ NUMÉRO DE DOSSIERS
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MED / DDRM		
BU / UB		**Letter ID/ N° d'identification de la lettre :**
		BMQ- | **BMQ-**

CONSULTATION:	Letters to be mailed by :
Departmental Legal Services Unit (Department of Justice), and the following Immigration, Refugee and Citizenship Canada areas: Finance and Communications.	☐ **MED** ☐ **Branch** **APPROBATION / Bureau du ministre**

GCDOCS :

184881393 (Memo)
176224176 (Annex)

ACCOUNTABILITY/RESPONSABILITÉ :

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Page 1285

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23

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2016–2017
Operations Sector Executive Summary:
P12 Planning Update

Robert Orr
ADM – Operations Sector
May 2017

Prepared by: Strategic Planning, Reporting & Investment Management Division
Operations Planning and Performance Branch

Canada

Page 1287

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est non pertinente

- setting up tools (e.g., risk factor model, predictive analytics pilots)

N/R

N/R
- Maintaining processing times despite increasing volumes (i.e. improvements to TR processing, predictive analvtics)

Page 1289

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est non pertinente

N/R

N/R

5

Page 1291

is not relevant

est non pertinente

• Meeting long-term processing objectives depends on leveraging innovation. Analytics technology can facilitate reduced investment in physical infrastructure, and reallocation of resources to focus on complex cases.

7

Secret

Sector Focus: Risk

ISSUE	CONSIDERATIONS	FORWARD PLAN
Predictive Analytics to Improve Efficiency	• It will be increasingly difficult to manage growing volumes (e.g. TR) if predictive analytics is not implemented as a risk management tool to improve processing efficiency.	

Processing Times

8

Secret

Sector Focus: Client Service

ISSUE	CONSIDERATIONS	FORWARD PLAN
Client Support Centre Modernization	• Client Support Centre (CSC) quality assurance program revised to measure excellence in alignment with IRCC Service Excellence Action plan priorities. • Improvements to respond to the *Modernization of Client Service Delivery Report* tabled by the Standing Committee on Citizenship and Immigration in March 2017. • Limited ability to resolve service issues in the near-term given CSC is currently operating at full capacity, with relocation planned for spring 2018.	• Client service excellence initiatives will include increased accessibility for clients, use of analytics to predict client behaviour, and soft skills training for staff. • Pilot at CSC to engage staff in providing excellent client experience. • Timely collaboration among key partners (CPPG, DN, LDD, Communications) is key. •Implement initiatives from the Citizenship Design Challenge.

User-centric Design and Delivery

N/R

9

Management Considerations

Secret

- **Workload Management and Employee Wellness**: Employee change fatigue and 'burn-out' continue to be a risk due to frequent changes to organizational structure, legislation, and priorities. Measures to address include training and proactive change management and will be essential through the transition to a predictive analytics driven organization.

15

s.16(1)(b)

s.16(2)

N/R

N/R

N/R

N/R

16

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Predictive Analytics

N/R

Key Activities	Lead Branch/Network
• Further predictive models will be developed for China and pilot scoping is planned for India TR lines of business	OPP
• Pending a successful pilot for Citizenship, a model will be implemented for risk triage	OPP
• Pending a successful pilot for Family Class, risk indicators will be implemented for risk triage in 2017–2018, with expansion in 2018–2019	OPP

19

Secret

2015-2016 P12 / 2016-2017 Plan Adjustments for Operations Sector

May 2016

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Immigration Canada   Immigration Canada

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N/R

- A data mining project to identify fraud as well as work on predictive analytics indicators and models has been initiated to support Global Affairs Canada on trade and commerce with the United States.

N/R

N/R

10

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N/R

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N/R

13

Pages 1318 to / à 1327

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N/R

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N/R

N/R

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2016-2017 Risks Operations Sector will Mitigate

Risk A – Failure to fully deliver on priorities and core objectives due to extensive change agenda

The Operations Sector is undertaking and planning the following key actions in 2016-2017 to mitigate Corporate Risk 'A':

N/R

- Predictive Analytics Models development: (i) Predictive Analytics Models will be finalized and presented to Working Groups (International Experience Class, Visitor Record-Extension, Student Permits, Temporary Foreign Worker, Temporary Resident Visa); (ii) Operations Performance Management Branch will provide funding to Solutions and Information Management Branch to design and cost the IT infrastructure required for model deployment; and (iii) work will continue on risk indicators for Electronic Travel Authorization Expansion countries.

N/R

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PATRICK'S PART

How is this item different from most Policy Committee items?

- There's no deck. It's about a paper. We want you to read the paper.

Where did this project come from?

- A little history of the team – e.g. IRPA Part 4.1, other work on innovation
- In the summer of 2017, SPP Branch's Digital Policy team developed and consulted a series of issue papers relating to the future of e-tools and automation: topics like paperless applications and authorizations, the elimination of place-based application requirements, procedural fairness for clients, oversight of electronic systems
- In the fall, TBS developed and widely distributed a *White Paper on Responsible Artificial Intelligence in the Government of Canada*
- In December, SPP presented to ExCom an update on our work to ensure that the Department's policy and legal authorities support broader use of technology across all program lines
- As part of our forward plan, SPP Branch committed to developing a white paper in 2018 to help the Department think through the wide-ranging implications of technological innovation
- Some broader GoC context: TBS Standard and GAC development of a Canadian position

What do we hope to achieve with this paper?

- Boost the Department's digital literacy
- Give people a common lexicon and framework for understanding the specific technologies that are relevant to IRCC's operations, as well as a basis for weighing the risks and benefits associated with each;
- Sensitize people to risks that may not be apparent at first glance
- Provide interim guidance to program designers, policy analysts and senior managers; and
- Ultimately, kick-start a larger effort to ensure that as the Department continues to use technology in new ways, we ensure fairness and transparency for applicants, we mitigate new and unexpected risks, and we realize the full potential of transformative tools.

What is this paper NOT trying to do?

- Outline a technology grand strategy for the Department
- Catalogue all tech-centric projects at IRCC
- Prescribe specific policy or program design choices

1

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GREGG'S PART

I'll start by talking about who the paper is meant for and what it covers.

- The paper is meant for:
  1. program designers – business owners, operational project leads
  2. policy analysts or legal counsel
  3. senior managers

Less so, but still: those who work in IT, information management, HR, ATIP

- Our paper builds on the TBS white paper, and focuses on IRCC's specific set of challenges and opportunities.
- It includes a discussion of artificial intelligence, but casts a wider net.

We knew we had to put some limits on the discussion. You can't write a white paper about "new technology."

After some spirited debate, we settled on the following **four tests** to determine what technologies are in scope for a discussion about digital transformation at IRCC:

1. **Does the technology fall within the definitions of data analytics, automation or artificial intelligence?**

2. **Do applications of the technology relate to outward-facing activities that are governed by the Department's legal framework?** i.e. Do they relate to activities that ultimately affect external clientele, as opposed to strictly internal business such as HR and financial management?

3. **Beyond achieving efficiencies, could the technology alter decision-making processes or otherwise affect the fortunes of IRCC's clients?** i.e. Could technological change have unintended consequences or cause differential impacts on applicants, resulting in new "winners" and "losers"?

4. **Are applications of the technology proximate enough? Is piloting or implementation conceivable within the next three years?**

If people at this table are answering yes to these questions, we would really like to work with you to help you sort out the ethical, policy and legal issues.

With the scope established, the paper then goes on to break down the issues in three core sections:

(1) Potential benefits of these new technologies

(2) Risk considerations (which I would call "pitfalls")

(3) Guiding principles and some practical recommendations to guide work that is in its early stages

2

The <u>advantages</u> of digital transformation are, by and large, well understood throughout the Department. They include:

❖ Reducing application backlogs and processing times

❖ Freeing up officers to conduct more value-added activities, such as quality assurance or in-person interactions with clients

❖ Strengthening program integrity

❖ Improving client service with electronic tools that can work around the clock, with greater efficiency, and in ways that clients find inherently more convenient

❖ Making sense of the flood of client feedback about policy and program changes, thanks to text analytics that can deliver powerful sentiment analysis

❖ There are others

The pitfalls of digital transformation are perhaps less well known. This is the real meat of the paper. Some of the big risks include:

❖ **Innovation could outpace our legal and policy frameworks.**

- A new part 4.1 of IRPA provides broad Ministerial authorities for the use of technology in immigration lines of business, but other <u>language throughout the Act and its regulations reflects a presumption of physical documents and paper applications.</u>

❖ **The Department's existing privacy framework will almost certainly be encroached upon.**

- <u>Data-driven technologies are, in a sense, fundamentally at odds with privacy aims</u>. Data analytics and machine learning are all about feeding the machine as much data as possible. Conventional privacy wisdom is all about limiting the use of information to the original, narrow purpose for which it was provided.

- Data needs drive <u>increased information sharing between IRCC programs and with partners</u>, and we will need to ensure <u>appropriate legal authorities</u> to mitigate privacy risks.

- I know that IRCC's privacy experts are already thinking about things like
  o <u>Revising PIAs</u> as we incorporate advanced analytics and automation
  o "Doubling down" on <u>Privacy by Design</u> principles so that they become a default mindset

s.21(1)(a)

s.21(1)(b)

s.23

- ❖ Introducing automated decision-support systems into our administrative decision-making processes could cause clients to identify **a lack of fairness and transparency**, and IRCC could inadvertently **contravene principles of administrative justice.**

- ❖ There is lots in this section, and I won't go through it all. But here we are talking about things like:

- ❖

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So there are some serious risks….but we didn't want to leave the reader with a sense of trepidation about innovation. A lot of thinking has been done in this area, and there are some nuggets of wisdom at the back end of the paper. (I'd like to just highlight a few of them.)

The paper mainly proposes <u>guidelines for the responsible use of new technologies</u> in administrative decision-making and client service. Among them:

- <u>Let computers focus on their strengths</u> – reliably analyzing large volumes of data and considering millions of possibilities without fatigue – and let humans focus on theirs: intuition, creativity, empathy, social skills, shaping a larger strategy. Machines are best at choosing *answers*, humans are best at choosing *questions*.

- When determining whether a task or step in a decision-making process could be shifted from humans to machines, program designers should ask themselves, "<u>Is this a situation in which reasonable minds may differ?</u>" If yes, automation would seem ill-advised.

- <u>Data will always bear the marks of its history</u>. In using data to train a system to make equitable recommendations or decisions, we must be fully aware of the workings of this history.

- In a future business model centred on analytics and automation, clients will still have the right to an explanation of IRCC's decisions, and this explanation need not jeopardize program integrity. <u>There are ways to explain decisions made by algorithmic systems without disclosing the source code and allowing people to game the system.</u>

- We must <u>take ownership for the successes and failures of electronic systems</u>. Tools like chatbots should be treated as agents of the organization and held to the same standards as human agents.

(Since I couldn't help myself) the paper ends with some other recommendations that relate to creating the conditions for a successful digital transformation. These include:

- <u>Data quality</u> is the single greatest determinant of success in projects involving data analytics. Prioritizing analytics means prioritizing the breadth, depth and reliability of our data sets.

- Increase our store of <u>in-house expertise</u>. Recruit people with new skill sets and invest in education for existing personnel. <u>Data literacy</u> is important for all.

- <u>Build resilience</u> in preparation for major disruptions, be they lawsuits, cyber-attacks or other.

- Novel and complex as it is, <u>the technology is but one piece of the puzzle</u>. Removing barriers to adoption, changing long-standing business practices and <u>shifting our organizational culture</u> could be greater challenges.

- Get the <u>governance</u> right. <u>Remove artificial barriers that keep the right people from working together.</u>

- The success of innovative tools lies not in the technology per se, but in our ability to align it with our business models. (Human + machine → **hardest part is the +**)

I've talked enough. We'd like to hear from you – in the
time we have left, and in the weeks and months to come.

QUESTIONS FOR THE TABLE:

Given that IRCC has numerous experiments in the works, TBS is preparing a regime to vet and oversee algorithmic systems, and GAC is preparing a Canadian position on AI for international relations, what should SPP do next?

- Create a tool, like a checklist, to help people assess and manage projects?
- Write a Departmental policy that lays out actual requirements, getting out ahead of what TBS will hand down in 2019?
- Cue up a senior management retreat on these issues?
- Something else?

To what extent are people thinking about these issues in their day to day work, as they contemplate policy changes and look to redesign our program lines?

- IRCC is developing or experimenting with data-driven approaches in the fields of administrative decision-making, fraud detection and client service, among others.

- Once ad hoc, IRCC is starting to view its innovation efforts through a **digital transformation** lens. For IRCC, this means:
  - ➢ Shifting our Department from a legacy approach to new ways of working and thinking using digital, social, mobile and emerging technologies
  - ➢ Integrating digital technology into all areas of our business, resulting in fundamental changes to how we operate and how we deliver value to clients
  - ➢ Cultural change that requires us to continually challenge the status quo, experiment often, and accept that some ideas will fail
- Advanced technologies, including advanced analytics, AI and machine learning, are seen as vital to the future success of the Department. We recognized that data is one of our most valuable assets, but also that we need to invest in the breadth, depth and reliability of our data sets. New tools are only as good as the data they draw upon. Data quality is probably the single greatest determinant of success in projects involving data analytics and/or machine learning.

- Some major issues that IRCC would like to see a GoC Data Strategy address:
  - ➢ Data literacy for all public servants – not just the data science community, but also policy analysts, program advisors, senior managers, etc.
  - ➢ Infrastructure limitations, especially bandwidth and cloud storage – including, but not limited to, the role and capabilities of Shared Services Canada
  - ➢ Privacy/shareability across program lines and across departments (implementing, wherever possible, a "tell me once" approach).
    - ▪ In an ideal world, IRCC would be able to access information such as entry/exit records and automated security assessments from the Canada Border Services Agency, or information about tax returns from the Canada Revenue Agency. A national Data Strategy could be a lever for legislative changes and/or information-sharing arrangements that may be needed to access data from other departments, or for new IT infrastructure to enable data transfer and processing.

Question: *Is this GoC Data Strategy exclusively inward-looking, or does it look outward as well?* i.e. Does it relate only to the activities of government, or also to how government regulates Canadian society and the economy to prevent harm to citizens?

- To the extent that the Strategy is outward-looking, we expect it would address Canada's legal and regulatory frameworks for intellectual property, privacy, competition, consumer protection and human rights – the idea being that our frameworks are out of step with a world in which data is a resource and related policy challenges cut across legal and jurisdictional silos.

- This component of a national Data Strategy would be concerned with policy innovation in the public interest, to avoid the barriers and uncertainties that come from a wait-and-see approach where a handful of multinational tech companies increasingly determine Canada's data ecosystem. It would, ideally, focus on how the Government of Canada can ensure that citizens control the data they and their institutions create.

- IRCC would have a role to play in this part of a national Strategy because we are an identify management organization. The Department holds one of the most extensive databases in the Government of Canada: tens of millions of passports and other travel documents issues to Canadians, and records on even more foreign nationals, many of whom will become permanent residents and citizens. All of this data must be stored securely, managed to safeguard privacy, and leveraged responsibly to deliver a client experience comparable to what people have come to expect from the private sector. IRCC can't do any of this alone; our success depends on partnerships with CBSA, ESDC, foreign governments, provinces and territories, airlines, educational institutions and others.

"Update: Advancing a Policy and Legal Framework to Support IRCC's Digital Transformation"

Background Information to Support Presentation to ExCom

In addition to the speaking notes embedded in the deck, the following has been developed to support your presentation to ExCom on the policy and legal framework for electronic tools.

Slide 3 – "Context"

- When this deck was presented to the DG Steering Committee and at Policy Committee, participants flagged that IRCC's digital transformation will have significant impacts beyond the operational, legal and policy spheres—such as on human resources, IT infrastructure, and program integrity.

    o While this is true, it should be emphasized that SPP Branch's work is limited to the policy and legal framework, and that these other issues will need to be considered and addressed by other areas of the Department.

Slide 4 – "Review of IRCC's Legislative and Policy Framework (Summer/Fall 2017)"

- Part 4.1 came into force on October 18th, 2017 and provides explicit authority for IRCC to make use of automation and electronic tools in immigration lines of business, including automated decision-making.

N/R   ◀

- Departmental consultations involved circulating our issue papers across IRCC's policy and operations sectors, Legal Services, SIMB, and Corporate Affairs Branch. Through this process we received working-level feedback which we incorporated into the papers.

- These papers were then rolled up into a deck which we shared with the DG steering committee and Policy Committee; feedback from these discussions have been incorporated into the deck for ExCom.

1

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- In terms of external consultation, SPP has been engaging with Michael Karlin at TBS who is leading the development of a white paper on the responsible use of artificial intelligence and automation in government. The issues he mentions and the solutions he proposes in this white paper align very well with our work. SPP has also participated in an interdepartmental dialogue on artificial intelligence/automation led by Policy Horizons and includes representatives from the Department of Justice, Innovation, Science and Economic Development, and others. Discussion at this meeting confirmed that we are looking at key issues that need to be addressed as we move to machine-assisted processing and decision-making.

N/R **Slide 5 –**

- Part 4.1 provides broad legal coverage, including for OPP's work on the China TRV pilot by providing authorities for the use of electronic systems to process applications; however, it was put in place based on what was envisioned in 2014-2015.

N/R

2

Slide 6 – "Issues: Fairness and Transparency"

N/R

Insights from this analysis can be built upon as similar analysis are undertaken for new uses of technology at IRCC.

- While LSU is responsible for advising the Department (especially Operations Sector) on legal and litigation issues related to specific technology-based projects, SPP will play a key role in bringing the key players together, building a knowledge base/centre of expertise and promoting consistency in the Department's approach to these legal and policy issues as they are addressed in the context of each new project.

3

s.21(1)(a)

s.21(1)(b)

s.23

Slide 8 – "Issues: Governance (Internal and External)"

- SPP Branch's Digital Policy team has been working closely with OPP and Legal Services Unit (LSU) to identify and address legal and policy issues related to the China TRV pilot. This cross-sectoral engagement should be considered a model for collaboration with internal partners on new uses of technology.

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Page 1372

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s.16(1)(b)

s.16(2)

## 1. ADVANCED ANALYTICS FOR IMMIGRATION APPLICATIONS

Starting in March 2018, online visa applications from China will be triaged by a model so that low-risk cases can

Based on recent pilots, it is expected that the use of advanced analytics will boost processing capacity and generate efficiencies. Deploying predictive models will allow officers to focus their attention on more complex cases, thereby strengthening program integrity, and faster application processing will shorten wait times and contribute to an improved client experience.

2. AN AI TOOL FOR IMMIGRATION LAW

IRCC and the Department of Justice are partnering in the development of artificial intelligence (AI)-powered tools to assist in immigration law. Such tools are expected to generate new insights and efficiencies in litigation management and the delivery of legal services. Specifically, the departments are seeking to develop, for discreet immigration law questions, tools that will:
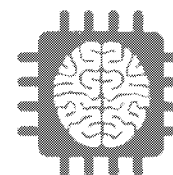
1. Support case law and legal research
2. Predict litigation outcomes and assist in the development of legal advice/legal risk assessments
3. Facilitate trend analysis in litigation to inform litigation strategies; for example, insights can be gained into key factors influencing the court in litigation that human review would not have revealed

Department of Justice counsel and paralegals support IRCC officials in reviewing, responding to and managing very high volumes of immigration legal issues and litigation. Some work that previously would have taken these officials hours to perform could be performed in minutes. In addition, the analysis performed would be more detailed and comprehensive due to the added power of machine learning technology applied to large data sets of information (e.g. reviewing all key facts of every case decided on a given legal issue).

AI tools for other areas of law have been developed by private industry but not for immigration law in Canada. A Request for Information (RFI) will be posted in early 2018, seeking industry feedback and insight into the development, use and scalability of AI-powered tools for immigration law. Employment and Social Development Canada will be joining this RFI to seek feedback from industry on AI tools for employment law.

The Department of Justice has set up a Task Force on AI to survey the current state of AI in the legal profession, its existing and potential applications, and the challenges and opportunities it may present.

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s.16(1)(b)

s.16(2)

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TRANSFORMATION AT IRCC: STRATEGIC FRAMING

CONTEXT

Following years of aggressive growth in temporary resident lines of business, and with simultaneous expansion on the permanent resident side, IRCC's processing network is stretched to the limit. Addressing these pressures with traditional reinforcements – more officers and more physical space – is not sustainable in the long term. The Department is adapting: we now have a Cabinet-approved Multi-Year Levels Plan, which better equips IRCC to manage inventories and meet permanent resident targets, and we have an integrated network vision to distribute workload across the Centralized, Domestic and International Networks according to each group's intake capacity and place-based expertise. These advancements notwithstanding, meaningful innovation in business processes is required to keep processing times and backlogs from increasing across all business lines.

Compounding the volumes issue, client expectations for quick and user-friendly services are increasing, in no small part because of the ubiquity of technology – in particular the rise of cloud, social media and mobile technologies that are changing the way we do things in every aspect of our lives. Worldwide demand for air travel continues to escalate, and the rise of a global middle class is swelling the ranks of mobile, tech-savvy individuals who are accustomed to a certain standard of digital interaction with private sector entities and now expect the same from governments.

Canada's international competitors are increasingly leveraging technology to streamline business practices in order to better attract tourists, business visitors and skilled permanent residents. As safety and security threats change in scope and complexity, like-minded countries are using new tools to analyze and manage risks. For Canada to keep pace, harnessing the potential of emergent technologies and other innovations will be critical.

The bona fide arrival of powerful technological capabilities brings with it significant opportunities for IRCC. Once largely theoretical, or at least the sole domain of leading-edge tech companies, the dramatic pace of technological change has brought tools such as digitization, data analytics, automation and machine learning into the mainstream. Recent years have seen a dramatic decrease in the cost of prediction due to advances in computational speed, data storage, data retrieval and algorithms. More widespread understanding of the technology is leading to commonplace use of "big data" – in health care, in education, in government administration of all types.

With this technological advancement has come a broader and more generalized focus on innovation, including within the Government of Canada, where it is now seen as a priority for most federal organizations. With leadership from the Privy Council Office's Innovation and Impact Unit and centres of expertise in various federal departments, including IRCC, organizations are leveraging new approaches, such as data analytics and user-centred design, to revolutionize service delivery models.

WHERE WE ARE GOING

IRCC has begun to take critical steps to experiment with new technologies and other innovative approaches to respond to external pressures and deliver on its mandate. The Department has created pockets of expertise in novel areas such as advanced analytics and behavioural insights, which, respectively, have the potential to play a significant role in reducing processing times and enhancing the client experience. Work is also underway to update and "future-proof" program design in key areas such a visitor visas, identity management and security screening. More broadly, our processing network is being examined across business lines to develop a more integrated and efficient service delivery model. This is on top of years of determined work to better manage volumes through better intake controls, inventory blitzing, and levels planning management.

Think piece for senior management discussion

The Department is now at a point in its maturity to fundamentally change the way it does business. Several key initiatives already underway are potential catalysts for a larger transformative shift:

The Advanced Analytics Project: The China TRV Pilot and Beyond

The Department reached a major milestone in 2017 with a highly successful pilot of a state-of-the-art predictive model for risk triaging and automated approval of low-risk online applications (e-Apps). IRCC piloted a predictive model to sort China visa applications into tiers – the lowest risk for auto-approval, medium and high risk for officer review. Over a three-week pilot in October/November 2017, the model took 42% of all e-Apps off of officers' hands, demonstrating the tremendous potential of this technology for relieving pressure on the processing network once e-Apps become the dominant application mode.

In March 2018, the model will be deployed in China as a permanent tool for daily processing, ·

he Operational Planning and Performance Branch will establish and grow an Advanced Analytics Lab to test more new ideas and concepts. In time, with advanced analytics used across the majority of business lines, the Department will find its processing model transformed.

A Focus on Client Experience

In January 2017, Client Experience Branch (CEB) was established to oversee the Department's Service Excellence in Action agenda, which focuses on the four principles of innovation, risk management, client experience and public confidence. With the understanding that service excellence is a shared responsibility across the Department, CEB brings leadership and expertise to develop client insights, drive user-centred experimentation and innovation, report on client impacts of ongoing initiatives and provide horizontal guidance to the Department, including through a departmental Service Strategy. CEB is also accountable for IRCC's primary front-end service model, including the Client Support Centre, which is expected to provide high quality and consistent client service by phone and email. With advanced analytics bringing transformational change to IRCC's back-end process, the work of CEB can have a similar impact on forward-facing activities.

N/R

A Horizontal Policy and Legal Framework Underpinning Automation, Analytics and e-Tools

Strategic Policy and Planning Branch, working in concert with Legal Services, is working to identify and address the policy and legal issues related to uses of technology. With the benefit of both enabling and challenge functions, the Department will be better able to determine what uses of big data, machine learning and automation are possible, permitted, and advisable. Established links with centres of expertise in central agencies (notably TBS) and the research community (notably Policy Horizons) will serve to bolster IRCC's policy capacity in this emerging area. A new Director General Committee focused on IRCC's e-Tools policy and legal framework can provide leadership as policy specialists begin to generate horizontal advice to inform the design of technology-related initiatives. A White

Paper in early 2018 will help to cement IRCC's status as a Government of Canada leader with respect to innovation and the responsible use of emergent technology.

While these initiatives are important pieces of the puzzle, a full-scale transformation will require work in other areas as well. Exploratory work is ramping up as follows:

A Future Vision for Visitors

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A cohesive transformative vision will depend on understanding and systematically managing the linkages between these various initiatives.

disadvantaged if our governance structures are not in step with the changing and increasingly significant role of IT in policy, program and operational changes.

The Department is at a critical pivot point. If we can find a way to integrate all of the initiatives described in this paper into a coherent implementation plan, we can begin to effectively tackle volumes, offer a client experience that lives up to applicants' expectations, and deliver on our mandate to provide a safe and secure immigration program for Canadians.

DISCUSSION QUESTIONS

➢ Do we buy into this description of IRCC's current state and vision for where we are going?

➢ If forced to choose, do some of these initiatives take priority over others?

➢ Are the leads clear for each strand of work, or do we need to build more "connective tissue" (e.g. working groups) around these? How can IRCC formalize linkages to ensure we maximize potential benefits?

➢ Does the Department have the necessary expertise to achieve full-spectrum change? What functions could be or should be outsourced to third parties?

➢ What engagement is required with other government departments (particularly CBSA given the critical importance of alignment), partners and stakeholders, and the public to support a successful transformation?

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s.21(1)(b)
s.23

AI Interdepartmental Dialogue Meeting – Oct 3, 2017

- While we're not yet currently in the world of Artificial Intelligence at IRCC, we could be moving in that direction and we feel that some of the activities currently underway raise many of the same policy and legal questions as the use of AI would.

- So what is IRCC doing? We're using of predictive analytics to help us processing immigration applications more quickly. Specifically, a group of data scientists in the Department has developed a predictive model to triage temporary resident visa applications based on risk. This model is currently being tested in China where it will identify low-risk cases that can be bulk approved without an officer review. In other words, large numbers of low-risk applications can be approved en masse without having to be reviewed by a human being.

- The model functions by mimicking officer decisions about whether an application should be approved or not and tries to predict the final decision that an officer would have made. To do this, the model analyzes thousands of past officer decisions to understand how combinations of applicant characteristics are linked with approval or refusals. Patterns which yielded almost unanimous agreement among officers in favour of approval are used to recommend future approvals ("green bin"). The rest are triaged to officers for review.

- This approach was initially tested in China in December 2016 and is going to be tested on a somewhat larger scale this Fall. Based on results of the initial testing, it is expected that the results will be positive and that there will be pressure to begin rolling out this approach more broadly given that demand for temporary resident visas is forever on the rise.

- In 2015, changes were passed to the Immigration and Refugee Protection Act that gave IRCC broad authority to use electronic tools, analytics and automation to processing immigration applications. These changes are not in force yet but will be published in the Canada Gazette on Oct 18th. :

- These are some of the questions we've been considering, among others, and we do a lot of discussing them among ourselves but we need outside perspectives, so we jumped at the opportunity to meet with this group. So with that, if anyone has any questions or guidance or anything else, we'd love to hear it.

s.21(1)(a)

s.21(1)(b)

DG Committee: Digital Transformation Policy/Legal Framework

• My DGO has reached out to many of your DGOs to ask that you provide a point of contact for this consultation. **Notes on the White Paper** • Last summer, your branches were consulted on the development of a series of issue papers related to new uses of technology. At the same time, TBS/Michael Karlin was developing a white paper on responsible use of artificial intelligence in the Government of Canada. • SPP Branch has built on this earlier work, as well as lessons learned from OPP's successful China TRV pilot, to develop our own white paper that frames the key benefits and risks of IRCC using emergent technologies. Primarily, we're talking about big data, automation and artificial intelligence, and principles and considerations for IRCC as it makes increasing use of these technologies. • SPP has been consulting areas of the Department whose work is specifically referenced in the paper, and then we'll be reaching out to TBS and other departments who are doing work in this space for an external perspective. • We will be looking for a way to officially "launch" the white paper, such as taking it to Policy Committee.		
NEXT STEPS AND FORWARD AGENDA • This Committee will meet again in the spring. • Agenda items may be brought to Amanda McPherson, Assistant Director, Digital Policy, SPP Branch		5 mins

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s.21(1)(a)

s.21(1)(b)

DG Committee: Digital Transformation Policy/Legal Framework

Notes on the TBS Automation Standard:

- TBS recently hosted an interdepartmental consultation to launch the development of a standard for departments pursuing automated decision-making.
- Scope: anything from process automation to AI; focus on administrative decisions that flow from legislation; broader than automated decision-making – includes decision support (e.g. system-generated recommendations to humans)
- TBS would like to ensure that Departments are sufficiently transparent in the use automated systems, and that they comply with ethical guidelines
- SPP and OPP both attended the kick-off meeting and will continue to support this work
- It's a two-way street: IRCC wants early warning of rules that might be coming, but we also have expertise to share and an interest in influencing this government-wide effort
- TBS aims to share v1.0 of its proposal with Chief Technology Officers this winter, then final approval by TB Secretary in the spring

3

A-2018-09320-001382

DG Committee: Digital Transformation Policy/Legal Framework

TERMS OF REFERENCE **DG Steering Committee: Digital Transformation Policy & Legal Framework** Documents: Terms of Reference **Notes:** • The Committee provides a cross-sectoral focal point to discuss policy and legal issues related to IRCC's use of new technology. • It is a time-limited undertaking – not part of IRCC's ongoing governance structure. • Not all new uses of technology are in scope – focus is on technology that transforms program design, necessitates new policy or legal authorities, or that could lead to legal challenges. ➢ For example, the automation of routine clerical tasks would **not** be in scope (like auto-promotion of applications in GCMS). This committee would be concerned with uses of technology that in some way influence, directly or indirectly, decisions on clients' applications (for example, by automatically triaging applications into low/medium/high risk categories). • It is requested that project leads whose work falls within scope present their plans to the Committee in the early stages of development. **Questions:** • *Do you support the Committee's mandate as stated in the draft Terms of Reference?* • *Does the Committee membership include the necessary players?*	**Matt de Vlieger,** SPP	15 mins

ROUND TABLE AND UPDATES ON KEY FILES
 	
Three things for SPP to mention:
  1. **TBS Standard on Automated Decision Support Systems**
 	
  3. **An IRCC White Paper –** *Digital transformation at IRCC: Benefits, risks and guidelines for the responsible use of emergent technologies*
 	
OPP (attendance TBC) should be able to give a debrief on the February 5th Min-DM.
Admissibility Branch will provide a debrief on the Visa Innovation DG Lock-Up.
	All	25 mins

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s.21(1)(b)

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DG Committee: Digital Transformation Policy/Legal Framework

February 9, 2018   3:00-4:00pm
JETS A1801

ANNOTATED AGENDA

Item	Presenter	Time
WELCOME AND TOUR DE TABLE	**Matt de Vlieger**, SPP	5 mins
POLICY AND LEGAL FRAMEWORK FOR IRCC'S DIGITAL TRANSFORMATION – DEBRIEF FROM EXCOM For reference: Deck to ExCom **Notes:** • Presentation was well-received by ExCom. • Members agreed to formalize a multi-sectoral DG Committee. • Recommended that IRCC engage external partners (in particular the CBSA) on changes to policy and legal framework to broaden our use of technology.	**Matt de Vlieger**, SPP	10 mins

• Technology use could produce cost savings for IRCC, with impacts on our fee structures.
   o Finance to be engaged on the DG Steering Committee as needed.
• Agreement that the Minister should be briefed on the China TRV Pilot and how IRCC is addressing related policy and legal issues.
   o OPP presented on Feb 5 and SPP included content in their deck on how policy and legal issues have been addressed.

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Mandate

Numerous initiatives around the Department, ranging from client service to identity management to stakeholder collaboration, involve new technology in some capacity. Judging whether a particular technology is in scope for the Digital Policy team, and for the white paper we intend to bring forward, can be challenging. In making these determinations, we propose the following four tests:

1. Does the technology fall within the definitions of data analytics, automation or artificial intelligence?
2. Could the technology have a disruptive or transformative impact on the way the Department does business?
3. Do applications of the technology relate to outward-facing activities that are governed by the Department's legal framework (i.e. activities that affect, if indirectly, external clientele – as opposed to strictly internal business such as HR and financial management)?
4. Are applications of the technology proximate enough? Is piloting or implementation conceivable within the next three years?

If the answer to each of these four questions is yes, the Digital Policy team has a role to play in determining whether there are ethical, legal and policy issues that have yet to be fully considered.

Audience for a white paper

Core audience:
> Project Leads
> Modellers
> Senior Management (abridged version)
> Policy Analysts
> Legal Services

Secondary audience:
> IT
> HR
> Program integrity specialists
> ATIP
> Security

Not targeted at: Administrative decision-makers, officers in the field, programmers
> *Though the content of the white paper will eventually lead to and provide a basis for guidance to officers*

Type of advice

1. **Horizontal/functional advice focused on policy and legal issues related to uses of technology**
   > NOT vertical/program policy advice on what direction to take IRCC programs – but can inform program policy

2. **Enabling and challenge functions:**
   > Identifying policy and legal risks, requirements, what is possible/permitted
   > Identifying opportunities, best practices, what is possible/promising, what is advisable

3. **Identifying linkages to other functional areas (e.g. HR/change management, IT, program integrity)**
   > NOT assessing or advising on specific impacts or possible approaches in these areas

DG Steering Committee: Digital Transformation Policy & Legal Framework
Terms of Reference

Mandate

The Digital Transformation Policy and Legal Framework DG Committee (the Committee) provides a cross-sectoral focal point to discuss policy and legal issues related to IRCC's use of new technology. The Committee supports the Department regarding what uses of big data, advanced analytics, automation, and artificial intelligence are possible, permitted, and advisable for IRCC. It is a temporary body intended to support the Department during this time of transformation, and is not part of the Department's ongoing governance structure.

Scope

The Committee's focus is on technologies that have the potential to transform the way the Department does business; for example, technology that transforms program design, necessitates new policy or legal authorities, or that could lead to legal challenges. Technology that involves the simple replication of current processes using electronic systems or tools is out of scope. The Committee will manage any overlaps in mandate or other relevant linkages with other internal DG-level committees, such as the Information Sharing and Privacy Committee and the DG Information Management/Information Technology Committee.

Responsibilities

All Committee Members

- Ensure policy and legal issues related to new uses of technology are identified and addressed at the design and development stages of new projects;
- Provide strategic leadership and a necessary challenge function on the use of new technology;
- Provide a focal point for continued cross-sectoral engagement, information-sharing, knowledge building, and sharing of lessons learned around legal and policy issues related to new uses of technology.

Project Leads

- Present plans related to new uses of technology in the early stages of pilot/project development to ensure legal and policy issues are flagged ahead of approval, testing, and/or implementation.

Committee Membership

Chair

The Committee is chaired by the Director General of Strategic Policy and Planning (SPP) as the branch is leading efforts to put in place a policy and legal framework to support the broader use of new technology across program lines and IRCC's overall digital transformation.

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Regular Members

Membership includes Directors General from the Policy, Operations and Corporate Sectors, as well as senior representation from Legal Services.

Policy Sector
- Director General, Strategic Policy
- Director General, Admissibility
- Director General, Citizenship
- Director General, International and Intergovernmental Relations
- Director General, Immigration Branch

Operations Sector
- Director General, Operations Planning and Performance Branch
- Director General, Immigration Program Guidance
- Director General, International Network
- Director General, Centralized Network
- Director General, Domestic Network
- Director General, Citizenship and Passport Program Guidance
- Director General, Case Management Branch
- Director General, Client Experience Branch
- Director General, Migration Health Branch,
- Director General, Operations Strategic Projects Office

Corporate Services Sector
- Director General, Corporate Affairs
- Director General, Solutions and Information Management

Other
- Counsel, Legal Services

*Invitations will be extended to other DGs based on subject matter

Secretariat

SPP will coordinate the planning and preparation for meetings of the Committee.

Designated Alternates, Observers and Presenters
- Membership will be at the Director General (DG) level.
- Observers are permitted for specific agenda items as required.
- Other representatives may be invited to present or participate as required.

Last updated: February 9, 2018

A-2018-09320-001387

BRANCH: Strategic Policy & Planning   DATE: March 14, 2018

A WHITE PAPER ON DIGITAL TRANSFORMATION AT IRCC

ISSUE

- To provide you with a draft of SPP Branch's think piece entitled "Digital Transformation at IRCC: Benefits, risks and guidelines for the responsible use of emerging technologies"

BACKGROUND:

- At a December 4, 2017 meeting of ExCom, SPP Branch provided an update on its work to ensure that the Department's policy and legal authorities support broader use of technology across all program lines.

- As part of its forward plan, SPP Branch committed to developing a white paper in 2018 to help the Department think through the wide-ranging implications of technological innovation.

- Treasury Board Secretariat has developed and widely distributed a *White Paper on Responsible Artificial Intelligence in the Government of Canada*. Building on this piece, and on a series of issue papers developed by SPP Branch's Digital Policy team (with input from across the Department) in the summer of 2017, this paper focuses on IRCC's specific set of challenges and opportunities. The paper includes a discussion of artificial intelligence, but casts a wider net, incorporating also data analytics, automation and other electronic tools.

- The paper aims to:
  - Boost the Department's digital literacy;
  - Give people a common lexicon and framework for understanding the specific technologies that are relevant to IRCC's operations, as well as a basis for weighing the risks and benefits associated with each;
  - Provide interim guidance to program designers, policy analysts and senior managers; and
  - Kickstart a larger effort to ensure that as the Department continues to use technology in new ways, we ensure fairness for applicants, we mitigate new and unexpected risks, and we realize the full potential of transformative tools.

CURRENT STATUS:

- This is a first draft of the paper. While SPP Branch has consulted with a small group of subject matter experts (some internal and some in other federal government departments), there are still a few place-holders where input from colleagues is outstanding.

- Contacts in the Operations Sector have expressed an interest in giving the paper to ADM Kochhar as soon as possible, in light of that sector's ongoing work to develop a Five-Year Strategic Plan. This is why we are providing a draft to you now, rather than waiting to send a final version.

NEXT STEPS:

- SPP/Digital Policy will continue to refine the paper, with a view to launching it Department-wide in the coming weeks via Policy Committee and other channels, such as the recently formalized DG Committee for a Digital Transformation Policy and Legal Framework.

WHAT IS AUTOMATION?

Automation is the training of computers to perform routine and repetitive tasks under conditions and in a manner pre-determined by people.

➢ At present, the Department is mainly interested in automating non-discretionary or easily defined steps in processing applications and communicating with clients, thereby freeing up officer time for more value-added activities, such as investigating complex cases or conducting quality assurance exercises.

Automation is often used as a catch-all term, encompassing a whole continuum of activities, from computerizing clerical tasks to automated decisions based on predictive analytics.

➢ Automation of routine, clerical tasks, while important, raises fewer issues from a legal standpoint. When a computer promotes applications to GCMS, this is an example of routine, clerical automation.

➢ We begin to cross the threshold from routine automation into automated decision-making when, for example, we use complex business rules to allow a computer to automatically triage applications based on their degree of risk.

➢ When the computer isolates applications tagged as "very low risk" and auto-approves them without an officer exercising a judgment function, we are fully in the realm of automated decisions.

➢ As we move along the automation continuum from the routine to the complex, we begin to see greater potential consequences for clients (and, by extension, for legal and policy frameworks) and for IRCC business processes.

PROGRAM LEADS SHOULD FLAG AUTOMATION PROJECTS THAT COULD HAVE DIFFERENTIAL IMPACTS ON CLIENTS

Some automation proposals can seem innocuous at first glance, but turn out to have significant legal and policy implications. In identifying automation projects in this category, program leads should ask themselves, **"Does the proposed machine intervention have any role to play in determining the outcome of a client's case? Could these changes potentially influence whether applications are ultimately approved or refused?"** If the answer is yes, programs leads should consult the Digital Policy group in SPP Branch. A legal opinion may also be required ensure that program-specific implications are identified and addressed.

In preparing for greater use of automation and automated decision-making, the Department needs to think carefully about how to:

— ensure procedural fairness for applicants
— explain outcomes to clients and demonstrate accountability for decisions
— create an audit trail in the event of a legal challenge
— prevent technological supports from fettering officer decision-making
— ensure that information retention and sharing respect privacy legislation

Note: SPP Branch is developing a white paper on the responsible use of emerging technologies, including data analytics, automation and machine learning. The paper will provide a detailed treatment of the pertinent policy and legal issues in early 2018. In addition, consideration is being given to formalizing a DG committee to guide the development of a legal and policy framework to support digital transformation.

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Electronic Tools, Automation, and Advanced Analytics at IRCC

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Purpose

- To provide an overview of:

  - three "game-changing" technologies that could help Department improve how it does business,

  - current examples and potential future uses of these technologies at IRCC, and

  - key considerations related to greater use of technology in delivering IRCC's programs and services.

- With a number of Departmental priorities having a technology angle – e.g. traveller facilitation and client service – it is an opportune time to explore whether IRCC as a whole should pursue greater use of technology and data to in the medium-term to improve how it does business more broadly (i.e. not simply in a piecemeal fashion)
- This deck provides an overview of what this could look like, what the benefits could be, and what we need to do as a Department to advance our use of technology and data, particularly with respect to ensuring legal authorities are in place to support this direction.
- The Government's focus on innovation and experimentation could be an opportunity for IRCC to move forward on a lot of the thinking and work it has done to support technological advancement.
- SPP has consulted with OPP, Admissibility and [SIMB?] in developing this product, but we need broader input as well and that's what we're hoping to achieve today.

Context

IRCC is **reducing processing times** via **expanded admissions space, inventory reduction, and renewed investments** in its current processing system (including funding secured in the 2016 Levels Plan).

But, **keeping pace with demand will not be sufficient** to ensure the success of our immigration system:

- Clients expect fast, streamlined, electronic service, and the Government has made it a priority to **improve client service** and **expand digital platforms** to meet these expectations;

- Canada's **international competitors** are increasingly using technology and new approaches to improve service delivery to attract tourists, business visitors, and global talent;

- **Safety and security threats** are growing in significance and complexity, necessitating the use of new tools to ensure the safety and security of Canadians and **maintain public confidence.**

The Department's chief assets – human resources, data and information technology (IT) – are in a constant state of evolution and need to be kept relevant in this changing global landscape.

- Over the past number of years, and also more recently over the course of 2015 and 2016, the Department has significantly advanced its ability to process an ever-increasing number of applications in a timely fashion.
- However, as demand continues to grow (and we expect that it will – if not for PR, certainly for TR), the way IRCC does business will need to evolve in step with its evolving operational context: technology is everywhere and, as a result, clients expect fast, electronic service; international competition will persist, with our competitors using the benefits of technology to help attract visitors and global talents; and safety and security threats are changing in scope and complexity and technology will be critical in our response to this shift.

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Three "Game-changers" for the Department

Electronic Tools

Definition: Any electronic means that assists human beings in carrying out tasks (e.g. e-apps, e-correspondence).

Use at IRCC: To speed interactions, reduce administrative burden and improve the processing experience for both clients and officers, as well as provide structured data to enable analytics and automation.

Advanced Analytics

Definition: Applying machine learning algorithms to improve decision-making by predicting probable events and rapidly adapting to new trends.

Use at IRCC: To develop and refine indicators to support decision-making, identify risk, and target officer time to the cases and activities that need it.

Automation

Definition: Using a system to perform routine and repetitive tasks under conditions and in a manner pre-determined by people.

Use at IRCC: To automate routine, repetitive, or easily defined processing steps or communications with clients, thereby freeing up officer time for more value-added activities (e.g. client service, quality assurance).

- These game changing approaches are:
  - **Electronic tools:** Tools that assist officers and clients in carrying out tasks, like electronic applications.
  - **Data & Predictive Analytics:** Using computer systems to analyze large quantities of data to identify trends and risk indicators in order to improve decisions how we make decisions on applications.
  - **Automation:** Using an electronic system to perform repetitive, non-discretionary tasks, like completing steps in application processing.
- To varying degrees, we already use these tools at IRCC as we'll see on the next few slides, as well as additional ways that they could potentially be deployed.

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Electronic Tools

Current Uses

* Electronic intake, processing, and storage of applications
* Grants and Contributions System (GCS)
* Electronic Travel Authorizations for visa-exempt travelers (eTA)
* Electronic applications (e-apps) in all temporary resident and Express Entry business lines
* E-Medical for electronic submission and processing of medical examinations
* Biometric collection
* SMS from mailroom to let family class clients know their application has been received

Potential Future Uses

Streamlined, paperless process for clients and officers, plus more and better data for IRCC via:

* Dynamic electronic e-apps that tailor the process to the applicant and provide structured data that the IRCC can leverage to improve decision-making
* Electronic travel documents (i.e. visas) and status documents (i.e. study and work permits) to reduce storage costs and provide flexibility for IRCC to cancel or modify status
* Expanded electronic communications (e.g. e-scheduler, e-correspondence)
* Entry/Exit data collection for a significant new data source on the outcomes of decisions
* Processing systems and tools that give officers speedy access to the information they need to make decisions

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Advanced Analytics

Current Uses

* Risk triage of in-Canada spousal inventory to allow streamlined processing of low-risk cases
* Pilot project to manage large volumes of low-risk China TRVs
* Preliminary work to find risk indicators of passport identity fraud
* Preliminary indicators of high-risk Mexican eTA cases

Potential Future Uses

A data-driven Department that employs risk-based (rather than rules-based) processes, allowing more targeted use of officer time, enhanced risk management, and a screening process that is tailored to an applicants' level of risk via:

* Analysis of large quantities of high quality data to identify "red flags" on high-risk cases and indicators of low-risk across all business lines (e.g. TR, PR, medical screening)
* Development of predictive models that support officer decision-making and enable automated processing, including automated decisions
* Analysis of Grants and Contributions data to improve program monitoring and help officers to better target fraud detection activities

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Automation

Current Uses

* Automated processing for the vast majority of eTA applications
* Automated clearance for medical results meeting certain criteria with e-Medical
* Automated ranking of candidates under Express Entry

Potential Future Uses

Officers are less frequently required for routine, repetitive tasks and focusing more time on value-added activities (e.g. interacting with clients, risk management, promoting IRCC programs), and applicants receive consistent, faster decisions via:

* Automation of workload distribution, routine processing steps, and, ultimately, decision-making in straightforward cases, expanded across lines of business
* Automated data security screening and data-sharing with security partners, Five Country Conference, and other partners
* Automation of routine, administrative client communication

IRCC's Evolving Delivery Model

Taken together, these changes would lead to an **increasingly virtual program delivery model** where IRCC and its officers harness **structured data** and **information-sharing** to manage volumes and risk while facilitating the majority of applications so that:

Most clients...
- Receive faster, more-tailored online services, applying and communicating with IRCC virtually on an ongoing basis
- Receive electronic travel/status documents that can be monitored and revoked
- Have their data shared more extensively to streamline future processes, build business intelligence, and improve program integrity

Officers...
- Spend less time on routine processing and engage more in intelligence gathering, quality assurance, and client service
- Use data more extensively to support decision-making
- Collaborate across a global network resulting in increasingly functional specialization

Relatives, employers, the public...
- See visitors, students, workers, and family members arrive in Canada faster
- Engage in two-way electronic information-sharing with IRCC (e.g. to validate study and work permits)
- Expect IRCC to make use of all available data sources to screen applications

Delivery partners...
- Work with IRCC to delivery a better client experience across the immigration continuum
- Seek access to IRCC's expanded data sets to enable their own program streamlining (e.g. security screening; provision of health services)
- Must adapt to our changing delivery approach

Using more technology and becoming a data-drive department will result in changes for clients, officers, stakeholders and our delivery partners.

- Clients will receive better, faster, more individualized online services, while also having their data used in more and different ways to improve the services we provide to them but also our own internal processes
- Officers will be supported by data and spend less time on routine processing steps, focusing more on value-added activities
- Stakeholders – like employers and universities, and sponsors of family members and refugees – will benefit from faster processes and, in some cases engage in two-way information-sharing with the Departments, such as universities sharing registration information with us and IRCC confirming status with them via an electronic portal
- Delivery partners will have to adapt and keep up with IRCC's technological advancement, but will also benefit from it through greater access to and more streamlined provision of data.

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READINESS: Legal Authorities

- In 2015, a series of new provisions under Part 4.1 of the *Immigration and Refugee Protection Act* (IRPA) set out clear **authorities for the use of electronic tools and systems** (including automation), and gave IRCC **authority to make regulations** governing the use of these systems.

- These **amendments are not in force**; when they are, they will allow IRCC to further leverage technology to improve processing efficiency, client service, and program integrity in the temporary and permanent resident business lines.

CONSIDERATIONS:

- In 2015, IRPA was amended to include a series of provisions allowing the IRCC to use electronic tools and systems in its operations - basically, these provisions allow the Department to carry out any of its TR and PR operations using an electronic tool or system, clarifying the scope of its authority with respect to the use of technology.
- However, these amendments are not yet in force - before pursuing technological advancement for client service transformation or other improvements, we need to bring them into force.
- [Memo status?]

More details on amendments if required:

The amendments to *IRPA*:
- Clarify authorities to use electronic application, processing and payment systems in all TR and PR lines of business and explicitly permit the use of automated-decision making;
- Establish the authority of the Minister to make the use of an electronic tool or system mandatory through regulations;
- Provide a new authority for the Minister to direct the use of any means of application in circumstances defined by regulation.

The amendments to *IRPA* include regulation-making authorities to:
- Specify details regarding the technology and systems to be used and matters relating to that system (i.e. the date/time when electronic documents or information are deemed to be sent or received);
- Require the use of an electronic system or means (including an e-payment system), as well as to specify exceptions to that requirement (e.g. in cases of disability);
- Prescribe circumstances where the Minister may direct the use of alternate means (e.g. in cases of natural disasters);

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READINESS: Client Service/User Experience

- To date, IRCC 's IT development has **focused on functionality and efficiency** of back-end systems designed to collect, process and store applications.

- User (officers or applicant) **experience has not been a primary focus** given:

  o historical mandate concerned more with risk mitigation than facilitation;
  o emphasis on financial efficiency rather than the creation of value-proposition;
  o project approach that has allowed little ongoing user testing & adjustments; and
  o massive change agenda as IRCC adopts e-processing across all of its operations while safeguarding client data and maintaining system stability.

- As global competition for skills increases and client expectations evolve, the Department is increasingly **exploring e-tools that mirror private-sector counterparts** to deliver an effective and welcoming user interface.

- IRCC will need to determine if **3rd party delivery models** will be used to achieve e-service objectives in the way that Visa Application Centres (VACs) have been used to complement in-person service objectives.

- IRCC's recent **Family Class and Citizenship Grant design challenges** show how human-centered design can harness low-cost technology to improve user experience and process efficiency.

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To date, IRCC's service delivery has been largely **focused on processing efficiency** ("back office") rather than client experience, given an emphasis on risk management, financial constraint, and a significant change agenda across the Department's operations.

READINESS: Information Technology (IT) & Governance

- As information technology (IT) becomes the dominant method of IRCC program delivery, implementation of new initiatives will increasingly depend on **whole-of-Department engagement in technology-related decisions.**

  - Policy and program development must take into account the limits of IT capacity, feasibility, and functionality – IT cannot be an afterthought.

  - Many key policy and legal questions will arise and need to be addressed during the IT development process – program and policy areas will require IT literacy to effectively consider interactions between potential changes and enabling technologies.

- However, IRCC's current governance structures do not take into account the **changing and increasingly significant role of IT** in policy, program and operational changes; the Department's existing skill "siloes" are not sustainable as IT systems become central to service delivery, as well as program and policy design.

- Coherent technological change will require a **governance mechanism** to not only **align** Departmental priorities and policy initiatives, but also to **integrate** policy, legal, operational, and IT expertise.

SECRET

READINESS: Key Considerations

IRCC will need to explore a number of key questions to ensure that the use of technology helps rather than hinders its ability to deliver on its mandate.

LEGAL & POLICY QUESTIONS

- How will IRCC ensure **procedural fairness** and **mitigate other legal and litigation risks** in automated processing?

- How will IRCC's **risk tolerance** and **program integrity** approach need to change with automated processing?

- With predictive models based on historical data, how do we avoid replicating **historical biases** in automated processing?

- What **privacy issues** arise from new ways of using and sharing data?

- How can technology help optimally **balance client service and program integrity**?

OPERATIONAL & CORPORATE QUESTIONS

- What **oversight mechanisms** are needed when decisions are automated and based on complex data models?

- How will IRCC ensure **sustainability of its IT infrastructure** and **data security** in a more information- and data-rich environment?

- How will the **role of decision-makers** change with automated processing?

- What **skills** are required to optimize IRCC's use of technology?

- How will IRCC's **IT project approach** adapt to big data, analytics, and a focus on client service?

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Update: Advancing a Policy and Legal Framework to Support IRCC's Digital Transformation

Matt de Vlieger, Director General, Strategic
Policy & Planning Branch
December 4, 2017

Immigration, Refugees   Immigration, Réfugiés
and Citizenship Canada   et Citoyenneté Canada

Canada

Purpose

- To update you on SPP Branch's work to ensure IRCC's policy and legal authorities support broader use of technology across all program lines, including a proposed way forward to ensure the Department's policy and legal framework evolves to support a transformation of its program delivery model.

Context

- Worldwide, organizations are using technology to transform service delivery by providing online services, automating processes to speed service delivery, and using advanced analytics to improve service quality and risk management.

- In response to steeply increasing application volumes, changing client expectations, and government commitments to faster and better service, IRCC has been making increasing use of electronically-enabled processing and decision-making to maintain service standards.

- This transformation is having far-reaching implications, including for IRCC's IT infrastructure, program integrity, workforce and partners, as well as for the Department's policy and legal framework.

- SPP Branch is leading efforts to identify and address the **policy and legal implications** of this transformation to ensure IRCC has the right policy and legal authorities, support and guidance as we continue to use technology in new ways.

While digital transformation is an imperative for IRCC, it also raises significant policy and legal questions — addressing these questions will be critical to ensuring that the Department can fully realize new efficiencies made possible by technology.

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Review of IRCC's Legislative & Policy Framework (Summer/Fall 2017)

- In April 2017, DM Morgan approved an approach to put in place a policy and legal framework to support greater technology use at IRCC.
  - Part 4.1 of IRPA was brought into force in October 2017 providing broad Ministerial authorities for the use of technology,

- In summer/fall 2017 SPP Branch undertook a review of IRCC's legislative and policy framework and considered broader questions related to IRCC's plans by:
  - Reviewing literature and international best practices related to technology in delivering government services;
  - Developing a set of issue papers to identify key policy and legal issues related to electronic tools, automation and advanced analytics;
  - Consulting across IRCC on the issue papers to ensure comprehensive issue identification, including the establishment of a multi-sectoral ad hoc DG Steering Committee; and
  - Engaging with TBS and the Artificial Intelligence Interdepartmental Dialogue led by Policy Horizons.

- As a result of this process, key issues have been identified in the 4 following areas:

Fairness & Transparency   Governance   4

N/R

s.21(1)(a)

s.21(1)(b)

- While foundational legislative authorities exist in
  Part 4.1 for the use of technology in immigration
  business lines, gaps

Issues: Fairness and Transparency

- Current approaches to ensuring fairness and transparency revolve around officer-based decision-making.

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is withheld pursuant to sections

est retenue en vertu des articles

21(1)(b), 23, 21(1)(a)

of the Access to Information Act

de la Loi sur l'accès à l'information

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Issues: Governance (Internal and External)

- Across IRCC, there is acknowledgement that policy and legal issues (like operational or IT issues) are arising and need to be addressed as the service delivery model transforms.

  - To-date, including these perspectives has been ad hoc and based on the best guess/risk assessment of project leads.

  - Policy and legal experts need to be brought in at the early stages of projects to ensure that issues are identified and addressed.

- To achieve success with new uses of technology and consequent changes to our policy and legal framework, **consulting with external partners** (especially CBSA) will be critical given our shared role in administering IRPA/IRPR and delivering programs.

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s.21(1)(a)

s.21(1)(b)

Proposed Way Forward

These issues could be addressed via three areas of work:

Policy & Legal Guidance

- Ongoing policy and legal guidance on projects
- Engagement with vertical program areas that are incorporating technology into their future vision
- White paper to guide responsible use of technology and inform transition advice
- Engagement with the Centre (TBS) to align with guidance
- Review to identify and address related privacy issues
- Develop transition advice regarding scope of legal/policy framework changes

Governance

- Policy/Legal engage in e-tools development via ad hoc or existing structures
- Enhance governance through formalization of current multi-sectoral DG Steering Committee on E-Tools Policy/Legal Framework (see Annex B for potential Terms of Reference)
- External partner engagement

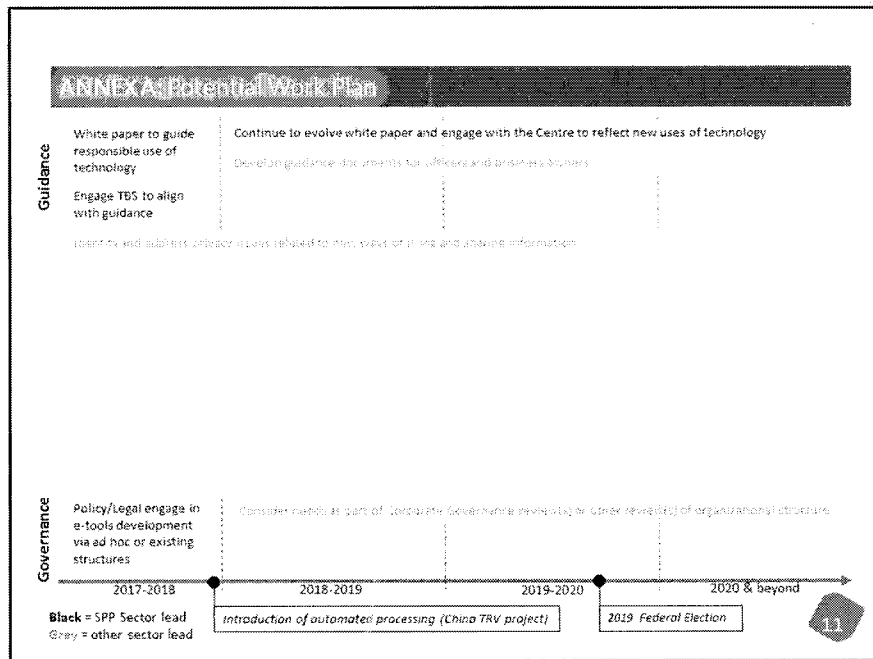*See Annex A for potential work plan*

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Questions

- Are these the right areas of work? Are there other **policy and legal issues** that need to be prioritized?

- Do you wish to engage the Minister on these policy and legal issues, or to focus that engagement via transition advice?

- Do you concur with the formalization of the DG Steering Committee on E-Tools Policy/Legal Framework?

NEXT STEPS:

- With ExCom endorsement, continue to advance the policy and legal framework to support IRCC's digital transformation, including:
  - carrying out work plan activities; and
  - improving governance around policy and legal components through the DG Steering Committee.

ANNEX A: Potential Work Plan

Guidance

White paper to guide responsible use of technology

Engage TBS to align with guidance

Continue to evolve white paper and engage with the Centre to reflect new uses of technology

Governance

Policy/Legal engage in e-tools development via ad hoc or existing structures

| 2017-2018 | 2018-2019 | 2019-2020 | 2020 & beyond |

Black = SPP Sector lead
Grey = other sector lead

Introduction of automated processing (China TRV project)   *2019 Federal Election*

ANNEX B: Potential Terms of Reference for DG Steering Committee

MANDATE: Continued engagement, information sharing and knowledge-building around legal and policy issues related to new uses of technology (including electronic tools, automation, advanced analytics).

SCHEDULE: Ad hoc

RESPONSIBILITIES:

- Project leads are expected to present plans related to new uses of technology in the early stages of pilot/project development to the Steering Committee to ensure legal and policy issues are flagged ahead of approval/testing/implementation.

- Leads can share policy and legal issues, mitigation strategies and solutions to help support development of a shared, coherent policy and legal framework underpinning these projects.

CORE MEMBERSHIP*:

- Policy Sector: DG-SPP (chair), DG-Admissibility, DG-Citizenship, DG-IIR

- Operations Sector: DG-OPP, DG-IPG, DG-IN, DG-CN, DG-CPPG

- Corporate Services Sector: DG-CAB, DG-SIMB

- Other: Legal Services Unit

*Invitations will be extended to other DGs based on subject matter

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MEMORANDUM TO THE ASSISTANT DEPUTY MINISTER, OPERATIONS

INNOVATION PROJECT FUNDED BY THE CANADIAN SAFETY AND SECURITY PROGRAM TO SUPPORT PREDICTIVE ANALYTICS

FOR INFORMATION

SUMMARY

- The Operations Planning and Performance Branch's (OPPB) Business Research, Intelligence and Analytics Directorate has won a second grant from the Canadian Safety and Security Program (CSSP) to support innovative research.

- Under the new project, entitled *Chain of Trust*, OPPB will receive $237,000 in 2017-18 to use predictive analytics to develop risk indicators for the Electronic Travel Authorization Program (eTA).

- The *Chain of Trust* project builds on the success of the currently funded *FASTER PrivBio* project, slated to end in March 2017.

BACKGROUND:

The CSSP is a managed through Defence Research and Development Canada's Centre for Security Science, which regularly launches Requests for Proposals to fund research projects that enable advancements in Canadian public safety and security.

In 2015-16, OPPB was awarded $60,000 from the CSSP as part of a $1.2-million project called *FASTER-PrivBio*, which involves the CBSA, a private company and two universities. Slated for completion in March 2017, the project has successfully developed a prototype smartphone app that provides an innovative mobile end-to-end eTA application and border management screening process by leveraging the capabilities of the ePassport, smartphone technology, biometrics and self-service kiosks. This prototype uses innovative encryption algorithms and Privacy by Design Principles to ensure the security of corporate and personal information.

CURRENT STATUS:

OPPB and its partners were successful in obtaining funding for a new $1.3-million innovation project for 2017-18, called *Chain of Trust: Collaborative Risk Assessment for Air Traveller Programs*. The project will involve OPPB, the CBSA, WorldReach Software, Entrust Datacard, Face4 Systems and the University of Ottawa. OPPB will receive $237,000 in 2017-18 under this project.

The project builds on the spirit of the Beyond the Border strategy and on the proven fact that travellers are willing to volunteer private information in exchange for ease and speed at travel check points. The project aims to develop a prototype which will spearhead advancements in security and traveller convenience by:

1. Leveraging *FASTER-PrivBio* capabilities to collect additional data early in the travel continuum, including:

    and the online submission of the E311 Declaration Form prior to arrival in Canada.

2. Consolidating the data collected on the traveller throughout the travel continuum into a new transaction record, enabling the continuous and incremental verification of the traveller's identity and assessment of level of risk.

3. A privacy-respecting, collaborative predictive analytics risk assessment by IRCC and the CBSA, leveraging historical traveller information and trip-related data collected throughout the journey. IRCC and the CBSA will each develop their own predictive models to assess the risk level of each traveller. IRCC's risk assessments during eTA adjudication will be shared with the CBSA and incorporated into their own risk assessments. Additionally, as each traveller advances through the travel continuum, new data about the traveller will allow the CBSA to update its risk score and inform decisions about which travellers should be sent to secondary inspection at the port of entry.

    This innovative collaboration during risk triage will allow low-risk travellers to benefit from faster processing and improved client service, while high-risk individuals are flagged for greater scrutiny.

Although OPPB will act as Project Manager for the entire project, its activities will be focused on the third objective above, which aligns with IRCC's goal of leveraging predictive analytics to develop stronger risk indicators for the eTA program.

OPPB has considerable flexibility in how to allocate CSSP funds. The CSSP has confirmed that IRCC could use the funding for GCMS development costs to implement eTA risk indicators. This could occur, for example, if IRCC feels that some new risk indicators are sufficiently compelling to warrant modifying GCMS to trigger a manual review of certain applications.

NEXT STEPS:

The project charter is finalized and currently in the approval process. Once signed by partners and the CSSP, procurement activities to issue contracts with private-sector partners will be initiated with an objective of having contracts in place by April 1, 2017.

OPPB will receive $350,000 from the CSSP to manage a contract with WorldReach Software Corporation, which is responsible for the improvements to the smartphone app. The CBSA will manage contracts with the other project partners.

OPPB will continue to work closely with the Immigration Program Guidance Branch and Integrity Risk Guidance Branch during the development of risk indicators and the allocation of funds.

A demonstration of the prototype is planned for early 2018.

Simon Cardinal